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SPONSORED PROJECT INITIATION

Date: October 19, 1976

Project Title: Volume Laser Holographic Information Storage and Retrieval for Two-Dimensional Signal Processing

Project No: E-21-602

Project Director: Dr. Thomas K. Gaylord

Sponsor: U.S. Army Research Office, Research Triangle Park, NC 27706

Agreement Period: From 10/15/76 Until 1/14/78

Type Agreement: Grant No. DAAG29-76-G-0339

Amount: $49,722 ARO
4,371 GIT (E-21-349)
$54,093

Reports Required: Progress Report
Technical (when justified)
Final Report

Sponsor Contact Person (s):

Technical Matters

Electronics Division
U.S. Army Research Office
P.O. Box 1211
Research Triangle Park
North Carolina 27706

Contractual Matters
(thru OCA)

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U.S. Army Research Office
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Defense Priority Rating: None

Assigned to: Electrical Engineering (School/Laboratory)

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GEORGIA INSTITUTE OF TECHNOLOGY
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SPONSORED PROJECT TERMINATION

Posted 2/21/78

Date: 2/17/78

Project Title: Volume Laser Holographic Information Storage and Retrieval for Two-Dimensional Signal Processing

Project No: E-21-602

Project Director: Dr. Thomas K. Gaylord

Sponsor: U.S. Army Research Office, Research Triangle Park, NC 27706

Effective Termination Date: 1/14/78

Clearance of Accounting Charges: 1/14/78

Grant/Contract Closeout Actions Remaining:

- _ Final Invoice and Closing Documents
- X Final Fiscal Report and Closing Documents
- _ Final Report of Inventions
- X Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
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CA—4 (3/76)

FINAL REPORT

Contract No.: DAAG29-76-G-0339

Title: "Volume Laser Holographic Information Storage and Retrieval for Two-Dimensional Signal Processing"

Principal Investigators: T. K. Gaylord and R. Magnusson

In the area of holographic storage, fundamental recording and readout processes in high data capacity electro-optic crystals were studied. A new generalized dynamic theory (developed by us) was applied to the determination (for the first time) of the internal recording parameters of these materials and to how these parameters change during the laser holographic exposure and reconstruction processes.

In the area of holographic processing, a new type of massive two-dimensional parallel processing of digital data was presented by us in the journal Optics Communications and at the International Optical Computing Conference. In this type of processing, Boolean algebraic logic operations may be performed on many data bits in parallel. This processing requires very little additional hardware beyond that of the basic holographic data storage system. It has been shown that this type of system will be very powerful in various types of numerical and associative processing.

I-H 6—
Special Rpt.

HOLOGRAPHIC STORAGE BIBLIOGRAPHIES

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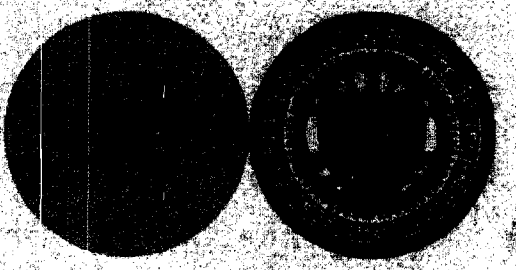

June 1977

Work Sponsored by

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HOLOGRAPHIC STORAGE BIBLIOGRAPHIES

by

T. K. Gaylord

June 1977

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TABLE OF CONTENTS

I. FORWARD

This document has been generated as a result of the large number of new published results in the general area of holographic storage. This report represents an attempt to list in one place the publications that directly relate to the following, somewhat more specifically defined areas:

1. Optical Holographic Memory Systems
2. Volume Holography and Thick Gratings
3. Optically-Induced Refractive-Index Changes in Solids
4. Optical Properties of Materials Related to Optical Storage

These four bibliographies contain references listed alphabetically according to the surname of the first author. No attempt has been made to produce an exhaustive listing. Thus numerous important references undoubtedly have been unintentionally omitted. Please notify the author of this bibliography of any pertinent references that are discovered to be omitted.

This report is an internal document prepared solely to aid researchers (faculty, graduate students, undergraduate students, etc.) in work related to the National Science Foundation and Army Research Office grants listed in the Acknowledgements section.

II. OPTICAL HOLOGRAPHIC MEMORY SYSTEMS

[1] Aagard, R. L., Lee, T. C., and Chen, D., "Advanced Optical Storage Techniques for Computers," Appl. Optics, vol. 11, no. 10, pp. 2133-2139, October 1972.

[2] Akaev, A. and Maiorov, S. A., "Optimal Relationships Between Geometric Parameters of a High-Capacity Holographic Digital Memory," Sov. J. Quant. Electron., vol. 5, no. 4, pp. 384-388, 1975.

[3] Akaev, A. and Maiorov, S. A., "Method for Recording an Array of Fourier Holograms Avoiding Mutual Interference," Sov. J. Quant. Electron., vol. 5, no. 5, pp. 519-523, 1975.

[4] Akahori, H. and Sakurai, K., "Information Search Using Holography," Appl. Optics, vol. 11, no. 2, pp. 413-415, February 1972.

[5] Alford, C. O. and Gaylord, T. K., "The Potential of Multi-port Optical Memories in Digital Computing," Digest of 1975 International Optical Computing Conference, pp. 121-123, April 25, 1975.

[6] Alphonse, G. A., "Broadband Acoustooptic Deflectors: New Results," Appl. Optics, vol. 14, no. 1, pp. 201-207, January 1975.

[7] Alphonse, G. A. and Phillips, W., "Read-Write Holographic Memory with Iron-doped Lithium Niobate," Ferroelectrics, vol. 10, pp. 397-401, 1976.

[8] Amodei, J. J. and Bosomworth, D. R., "Hologram Storage and Retrieval in Photochromic Strontium Titanate Crystals," Appl. Optics, vol. 8, no. 12, pp. 2473-2477, December 1969.

[9] Amodei, J. J. and Staebler, D. L., "Holographic Pattern Fixing in Electro-Optic Crystals," Appl. Phys. Letters, vol. 18, pp. 540-542, June 15, 1971.

[10] Amodei, J. J., Phillips, W., and Staebler, D. L., "Improved Electro-Optic Materials and Fixing Techniques for Holographic Recording," Appl. Optics, vol. 11, pp. 390-396, February 1972.

[11] Amodei, J. J. and Staebler, D. L., "Holographic Recording in Lithium Niobate," RCA Review, vol. 33, pp. 71-93, March 1972.

[12] Anderson, L. K., "Holographic Optical Memory for Bulk Data Storage," Bell Labs Record, vol. 6, pp. 318-325, November 1968.

[13] Anderson, L. K., "Optical Memories-1971," Electro-Optical Systems Design, vol. 3, pp. 26-28, January 1971.

[14] Anderson, L. K., "Application of Holographic Optical Techniques to Bulk Memory," IEEE Trans. Magnetics, vol. MAG-7, pp. 601-605, September 1971.

[15] Anderson, L. K., "Optical Applications of Ferroelectrics," Ferroelectrics, vol. 7, pp. 55-63, 1974.

[16] Assour, J. M. and Lohman, R. D., "A Photodetector Array for Holographic Optical Memories," RCA Review, vol. 30, pp. 557-566, December 1969.

[17] Bardos, A., "Wideband Holographic Recorder," Appl. Optics, vol. 13, no. 4, pp. 832-840, April 1974.

[18] Bardos, A. M., Montgomery, R. M., and Roberts, H. N., "Gigabit/Second Recording with Holography," Proceedings of the Technical Program of the Electro-Optical Systems Design Conference, New York, NY, September 1973, pp. 90-101.

[19] Bardos, A. M., Nelson, R. H., and Shuman, C. A., "High Data Rate Holographic Recording," Proceedings of the Technical Program of the Electro-Optics Systems Design Conference, San Francisco, CA, November 1974, pp. 126-133.

[20] Barrekette, E. S., "Trends in Storage of Digital Data," Appl. Optics, vol. 13, no. 4, pp. 749-754, April 1974.

[21] Baugh, R. A., "High-Efficiency Volume Holography," Ph.D. Thesis, Stanford University, 1969.

[22] Bergstein, L. and Kermisch, D., "Image Storage and Reconstruction in Volume Holography," Proc. Symp. on Modern Optics, MRI ser., vol. 17. Brooklyn, NY: Polytechnic Press, 1967, pp. 655-680.

[23] Bousky, S. and Diermann, J., "Characteristics of Scanning Laser and Electron Beams in Bulk Data Storage," IEEE Trans. Magnetics, vol. MAG-7, pp. 594-598, September 1971.

[24] Brown, B. R., "Optical Data Storage Potential of Six Materials," Appl. Optics, vol. 13, no. 4, pp. 761-766, April 1974.

[25] Carlsen, W. J., "Holographic Page Synthesis for Sequential Input of Data," Appl. Optics, vol. 13, no. 4, pp. 896-903, April 1974.

[26] Carlson, F. P. and Francois, R. E., "Generalized Linear Processors for Coherent Optical Computers," Proc. IEEE, vol. 65, no. 1, pp. 10-18, Jan. 1977.

[27] Casasent, D., "Materials and Devices for Coherent Optical Computing," Optical Information Processing, Y. E. Nesterikhin, G. W. Stroke, and W. E. Kock, Eds. New York: Plenum Press, 1976.

[28] Casasent, D., "Spatial Light Modulators," Proc. IEEE, vol. 65, no. 1, pp. 143-157, January 1977.

[29] Chen, F. S., Denton, R. T., Nassau, K., and Ballman, A. A., "Optical Memory Planes Using $LiNbO_3$ and $LiTaO_3$," Proc. IEEE, vol. 56, no. 4, pp. 782-783, April 1968.

[30] Chen, F. S., LaMacchia, J. T., and Fraser, D. B., "Holographic Storage in Lithium Niobate," Appl. Phys. Letters, vol. 13, pp. 223-225, October 1, 1968.

[31] Chen, D., "Magnetic Materials for Optical Recording," Appl. Optics, vol. 13, no. 4, pp. 767-778, April 1974.

[32] Chen, D. and Zook, J. D., "An Overview of Optical Data Storage Technology," Proc. IEEE, vol. 63, no. 8, pp. 1207-1230, August 1975.

[33] Cosentino, L. S. and Stewart, W. C., "A Membrane Page Composer," RCA Review, vol. 34, pp. 45-79, March 1973.

[34] Crowell, M. H. and Labuda, E. F., "The Silicon Diode Array Camera Tube," Bell Sys. Tech. J., vol. 48, pp. 1481-1528, May-June 1969.

[35] Damon, R. W., McMahon, D. H., and Thaxter, J. B., "Materials for Optical Memories," Electro-Optical Systems Design, vol. 2, pp. 68-77, August 1970.

[36] D'Auria, L., Huignard, J. P., and Spitz, E., "Holographic Read-Write Memory and Capacity Enhancement by 3-D Storage," IEEE Trans. Mag., vol. MAG-9, no. 2, pp. 83-94, June 1973.

[37] D'Auria, L., Huignard, J. P., Siezak, C., and Spitz, E., "Experimental Holographic Read-Write Memory Using 3-D Storage," Appl. Optics, vol. 13, no. 4, pp. 808-818, April 1974.

[38] David, R. M., Parten, C. R., Hagler, M. O., and Kristiansen, M., "A Holographic Data Storage System Design Project," International J. of Elec. Engr. Educ., vol. 10, no. 4, pp. 296-303, 1973.

[39] Drake, M. D., "PLZT Matrix-Type Block Data Composers," Appl. Optics, vol. 13, no. 2, pp. 347-352, February 1974.

[40] Esho, S., Noguchi, S., Ono, Y., and Nagao, M., "Optimum Thickness of MnBi Films for Magnetic Memory," Appl. Optics, vol. 13, no. 4, pp. 779-783, April 1974.

[41] Eward, R. S., "Optical Memories are Alive and Well and Growing," Optical Spectra, vol. 9, no. 8, pp. 25-28, August 1975.

[42] Fan, G. J., "Magnetooptic Storage," IEEE Trans. Magnetics, vol. MAG-7, pp. 590-594, September 1971.

[43] Feinleib, J. and Oliver, D. S., "Reusable Optical Image Storage and Processing Device," Appl. Optics, vol. 11, no. 12, pp. 2752-2759, December 1972.

[44] Firester, A. H. and Heller, M. E., "Use of Diode Lasers to Recover Holographically Stored Information," IEEE J. Quan. Electronics, vol. QE-6, no. 9, pg. 572, September 1970.

[45] Fowler, V. J. and Schlafer, J., "A Survey of Laser Beam Deflection Techniques," Proc. IEEE, vol. 54, pp. 1437-1444, October 1966.

[46] Friedrich, O. M. and Dougal, A. A., "Optical Data Systems," Instrumentation Technology, pp. 43-47, May 1971.

[47] Friedrich, O. M. and Dougal, A. A., "Optical Data Systems, Part II: Processing Techniques," Instrumentation Technology, pp. 53-59, June 1971.

[48] Friesem, A. A., "Three-Dimensional Recording Media in Holography," Ph.D. Thesis, The University of Michigan, 1968.

[49] Gabor, D., Stroke, G. W., Restrick, R., Funkhouser, A., and Brumm, D., "Optical Image Synthesis (Complex Amplitude Addition and Subtraction) by Holographic Fourier Transformation," Phys. Letters, vol. 18, no. 2, pp. 116-118, August 15, 1965.

[50] Gaylord, T. K., "The High Capacity Storage Problem: Is Optical Holography the Answer?" Optical Spectra, vol. 6, no. 11, pp. 25-37, November 1972.

[51] Gaylord, T. K., "Optical Memories," Optical Spectra, vol. 8, no. 6, pp. 29-34, June 1974.

[52] Gaylord, T. K., Magnusson, R., and Weaver, J. E., "Digital Processing Capabilities Using Holographically Recorded Data Pages in Electro-Optic Crystals," Optics Communications, vol. 20, pp. 365-366, March 1977.

[53] Gentile, R. B. and Lucas, Jr., J. R., "The TABLON Mass Storage Network," Spring Joint Computer Conference, pp. 345-356, 1971.

[54] Gillis, G. E. Hoffmann and Nelson, R. H., "Holographic Memories--Fantasy or Reality?" Proceedings of the National Computer Conference, pp. 535-539, 1975.

[55] Goodman, J. W., "Operations Achievable with Coherent Optical Information Processing Systems," Proc. IEEE, vol. 65, no. 1, pp. 29-38, January 1977.

[56] Graf, P. and Lang, M., "Geometrical Aspects of Consistent Holographic Memory Design," Appl. Optics, vol. 11, no. 6, pp. 1382-1388, June 1972.

[57] Gray, E. E., "Laser Mass Memory System," IEEE Trans. Magnetics, vol. MAG-8, pp. 416-420, September 1972.

[58] Griffith, R. L., "Data Recovery in a Photo-Digital Storage System," IBM J. Res. Dev., vol. , p. 456, July 1969.

[59] Guzik, R. P., "Optical Data Recording: Frontiers and the Manifest Density," Electro-Optical Sys. Designs, vol. 6, pp. 22-29, June 1974.

[60] Hammond, A. L., "Optical Data Storage: Mass Memories for Future Computers?" Science, vol. 180, pp. 287-288, April 20, 1973.

[61] Haskal, H., Bernal, G., and Chen, D., "Subnanosecond Laser Recording in MnBi Thin Films," Appl. Optics, vol. 13, no. 4, pp. 866-868, April 1974.

[62] Heilmeier, G. H. and Goldmacher, J. E., "A New Electric Field Controlled Reflective Optical Storage Effect in Liquid Crystal Systems," Proc. IEEE, vol. 57, no. 1, pp. 34-38, January 1969.

[63] Heilmeier, G. H., "Liquid Crystal Display Devices," Scientific American, vol. 222, pp. 100-106, March 1970.

[64] Hershel, R. S., Scott, P. W., and Shrode, T. E., "Image Sampling Using Phase Gratings," J. Opt. Soc. Am., vol. 66, no. 8, pp. 861-863, August 1976.

[65] Hill, B., "Some Aspects of a Large Capacity Holographic Memory," Appl. Optics, vol. 11, no. 1, pp. 182-189, January 1972.

[66] Hill, B. and Schmidt, K. P., "New Page Composer for Holographic Data Storage," Appl. Optics, vol. 12, no. 6, pp. 1193-1198, June 1973.

[67] Hodges, D. A., "Computer Memories," IEEE Student J., vol. 8, pp. 15-20, September 1970.

[68] Hou, S. L. and Oliver, D. S., "Pockels Readout Optical Memory Using $Bi_{12}SiO_{20}$," Appl. Phys. Letters, vol. 18, no. 8, pp. 325-328, April 15, 1971.

[69] Houston, G. B., "Trillion Bit Memories," Datamation, vol. 19, pp. 52-58, October 1973.

[70] Huignard, J. P., Micheron, F., and Spitz, E., "Optical Systems and Photosensitive Materials for Information Storage," Optical Properties of Solids New Developments, Seraphin, B. O., Ed. New York: North-Holland Pub. Co., American Elsevier Pub. Co., Inc., 1976.

[71] Huignard, J. P. and Spitz, E., "Holographic Memory Providing Both Angular and Translational Reference Beam Deflections," U.S. Patent No. 3,936,139, assigned to Thomson-CSF, February 3, 1976.

[72] Inagaki, T., Furukawa, Y., Goto, Y., Akimura, T., and Nishimura, Y., "Hologram Writer Using a Plasma Display Panel," Appl. Optics, vol. 13, no. 4, pp. 819-824, April 1974.

[73] Keneman, S. A., Miller, A., and Taylor, G. W., "Phase Holograms in a Ferroelectric-Photoconductor Device," Appl. Optics, vol. 9, no. 10, pp. 2279-2282, October 1970.

[74] Keneman, S. A., Taylor, G. W., and Miller, A., "Ferroelectric-Photoconductor Optical Storage Medium Utilizing Bismuth Titanate," Ferroelectrics, vol. 1, pp. 227-241, October 1970.

[75] Kermisch, D., "Image Storage and Reconstruction in Volume Holography," Ph.D. Thesis, Polytechnic Institute of Brooklyn, 1968.

[76] Kiemle, H., "Holographic Memories in the Gigabit Region," Appl. Optics, vol. 13, no. 4, pp. 803-807, April 1974.

[77] Kiemle, H., "Considerations on Holographic Memories in the Gigabit Region," Appl. Optics, vol. 13, pp. 803-807, April 1974.

[78] Kock, W. E., "Optical Computing, An Example of Change," Proc. IEEE, vol. 65, no. 1, pp. 6-9, January 1977.

[79] Kogelnik, H., "Coupled Wave Theory for Thick Hologram Gratings," Bell Sys. Tech. J., vol. 48, no. 4, pp. 2909-2947, November 1969.

[80] Kozma, A. and Barrekette, E. S., "Topical Meeting on Optical Storage of Digital Data," Appl. Optics, vol. 13, no. 4, pp. 747-748, April 1974.

[81] Knight, G. R., "Page-Oriented Associative Holographic Memory," Appl. Optics, vol. 13, no. 4, pp. 904-912, April 1974.

[82] Knight, G. R., "Holographic Associative Memory and Processor," Appl. Optics, vol. 14, no. 5, pp. 1088-1092, May 1975.

[83] Labrunie, G., Robert J., and Borel, J., "Nematic Liquid Crystal 1024 Bits Page Composer," Appl. Optics, vol. 13, no. 6, pp. 1355-1358, June 1974.

[84] LaMacchia, J. T., "Optical Memories: A Progress Report," Laser Focus, vol. 6, pp. 35-39, February 1970.

[85] Land, C. E. and Smith, W. D., "Reflective-mode Ferroelectric-Photoconductor Image Storage and Display Devices," Appl. Phys. Letters, vol. 23, no. 2, pp. 57-59, July 1973.

[86] Lee, T. C., "Holographic Recording on Thermoplastic Films," Appl. Optics, vol. 13, no. 4, pp. 888-895, April 1974.

[87] Lee, T. C., "Reflective Holograms on Thermoplastic-Photoconductor Media," Appl. Phys. Letters, vol. 29, pp. 190-193, August 1, 1976.

[88] Lee, W. H., "Optical Data Storage Using PPM and PWM," Appl. Optics, vol. 14, no. 9, pp. 2217-2224, September 1975.

[89] Leith, E. N., Kozma, A., Upatnieks, J., Marks, J., and Massey, N., "Holographic Data Storage in Three-Dimensional Media," Appl. Optics, vol. 5, no. 8, pp. 1303-1311, August 1966.

[90] Lin, L. H. and Beauchamp, "Write-Read-Erase in Situ Optical Memory Using Thermoplastic Holograms," Appl. Optics, vol. 9, no. 9, pp. 2088-2092, September 1970.

[91] Lipp, J. and Reynolds, J. L., "A High Capacity Holographic Storage System," in Applications of Holography, E. S. Barrakettee et al., Eds. New York: Plenum Press, 1971, pp. 377-388.

[92] Lo, D. S., "Photochromic Salicylideneaniline as Storage Medium for Interferometry and High Speed Recording," Appl. Optics, vol. 13, no. 4, pp. 861-865, April 1974.

[93] Luke, T. E., "Preliminary Investigations of a Bismuth Titanate Memory," IEEE Trans. Electron Devices, vol. ED-16, no. 6, pp. 576-579, June 1969.

[94] Macovski, A., "Hologram Information Capacity," J. Opt. Soc. Am., vol. 60, no. 1, pp. 21-29, January 1970.

[95] Maloney, W. T., "Optical Information Channels: Page-Accessed and Bit-Accessed," Appl. Optics, vol. 14, no. 4, pp. 821-823, April 1975.

[96] Maslowski, A., "High Density Data Storage on Ultraviolet Sensitive Tape," Appl. Optics, vol. 13, no. 4, pp. 857-860, April 1974.

[97] Mattson, R. L., "Role of Optical Memories in Computer Storage," Appl. Optics, vol. 13, no. 4, pp. 755-760, April 1974.

[98] Mend, W. G., McCoy, E. E., and Anders, R. A., "Micro-Miniature Solid-State Imaging System Utilizing Hybrid LSI Techniques," IEEE J. Solid-State Circuits, vol. SC-5, pp. 254-260, October 1970.

[99] Meyer, H., Riekmann, D., Schmidt, K. P., Schmidt, U. J., Rahlff, M., Schroder, E., and Thust, W., "Design and Performance of a 20-Stage Digital Light Beam Deflector," Appl. Optics, vol. 11, no. 8, pp. 1732-1736, August 1972.

[100] Mezrich, R. S., "Magnetic Holography," Appl. Optics, vol. 9, no. 10, pp. 2275-2278, October 1970.

[101] Mezrich, R. S. and Stewart, W. C., "Heterodyne Readout for Read-Write Holographic Memories," Appl. Optics, vol. 12, no. 11, pp. 2677-2682, November 1973.

[102] Micheron, F., Mayeux, C., and Trotier, J. C., "Electrical Control in Photoferroelectric Materials for Optical Storage," Appl. Optics, vol. 13, no. 4, pp. 784-787, April 1974.

[103] Micheron, F., "Photoferroelectric Materials and Applications to Optical Information Processing and Storage," Ferroelectrics, vol. 12, pg. 41, 1976.

[104] Micheron, F., Rouchon, J. M., and Vergnolle, M., "A Ferroelectric Image Memory," Ferroelectrics, vol. 10, pp. 15-18, 1976.

[105] Mityakov, V. G. and Fedorov, V. B., "Enhancement of the Effective Density of Data Storage in Optoelectronic Memories," Sov. J. Quantum Electron., vol. 6, no. 11, pp. 1284-1286, November 1976.

[106] Morozov, V. N. and Popov, Y. M., "High-Capacity Holographic Memories with Synthesized Aperture," Sov. J. Quantum. Electron., vol. 6, no. 11, pp. 1265-1271, November 1976.

[107] Motoki, T., "Low Voltage Optical Modulator Using Electrooptically Induced Phase Gratings," Appl. Optics, vol. 12, no. 7, July 1973.

[108] Nelson, R. H., VanderLugt, A., and Zech, R. G., "Holographic Data Storage and Retrieval," Optical Engineering, vol. 13, no. 5, pp. 429-434, September/October 1974.

[109] Ninomiya, Y., "Ultrahigh Resolving Electrooptic Prism Array Light Deflectors," IEEE J. Quantum Electron., vol. QE-9, no. 8, pp. 791-795, August 1973.

[110] Ninomiya, Y., "High S/N-Ratio Electrooptic Prism-Array Light Deflectors," IEEE J. Quantum Electronics, vol. QE-10, no. 3, pp. 358-362, March 1974.

[111] Nishida, N., Sakaguchi, M., and Saito, F., "Holographic Coding Plate: A New Application of Holographic Memory," Appl. Optics, vol. 12, no. 7, pp. 1663-1674, July 1973.

[112] Nomura, H. and Okoshi, T., "Storage Density Limitation of A Volume-Type Hologram Memory: Theory," Appl. Optics, vol. 15, no. 2, pp. 550-555, February 1976.

[113] Norman, S. L., "Holography in Unconventional Materials," Optical Spectra, vol. 4, pp. 26-30, November 1970.

[114] Okuda, M., Matsushita, T., Yamagami, T., and Yamamoto, K., "Highly Sensitive Light-Induced Memory Effect with Amorphous Se-SnO_2 Heterojunction," Appl. Optics, vol. 13, no. 4, pp. 799-802, April 1974.

[115] Oliver, D. S., Vohl, P., Aldrich, R. E., Behandt, M. E., Buchan, W. R., Ellis, R. C., Genthe, J. E., Goff, J. R., Hou, S. L., and McDaniel, G., "Image Storage and Optical Readout in a ZnS Device," Appl. Phys. Letters, vol. 17, no. 10, pp. 416-418, November 15, 1970.

[116] Patlach, A. M., "Design Considerations for a Magnetic-Optic Cryogenic Film Memory," IBM J. Res. Develop., vol. 16, pp. 313-319, May 1972.

[117] Pohl, D., "Stacked Optical Memories," Appl. Optics, vol. 13, no. 2, pp. 341-346, February 1974.

[118] Powers, R. S. and Goodman, J. W., "Error Rates in Computer-Generated Holographic Memories," Appl. Optics, vol. 14, no. 7, pp. 1690-1701, July 1975.

[119] Rajchman, J. A., "Promise of Optical Memories," J. Appl. Phys., vol. 41, no. 3, pp. 1376-1383, March 1, 1970.

[120] Rajchman, J. A., "An Optical Read-Write Mass Memory," Appl. Optics, vol. 9, no. 10, pp. 2269-2271, October 1970.

[121] Rajchman, J. A., "New Memory Technologies," Science, vol. 195, pp. 1223-1229, March 18, 1977.

[122] Ramberg, E. G., "Holographic Information Storage," RCA Review, vol. 33, no. 1, pp. 5-53, March 1972.

[123] Roberts, H. N., "Strain-Biased PLZT Input Devices (page composers) for Holographic Memories and Optical Data Processing," Appl. Optics, vol. 11, no. 2, pp. 397-404, February 1972.

[124] Roberts, H. N., Watkins, J. W., and Johnson, R. H., "High Speed Holographic Digital Recorder," Appl. Optics, vol. 13, no. 4, pp. 841-856, April 1974.

[125] Sander, B. T., "Optimization of Thin Holographic Data Storage Systems," Ph.D. Thesis, Washington University, 1972.

[126] Shankoff, T. A., "Phase Holograms in Dichromated Gelatin," Appl. Optics, vol. 7, no. 10, pp. 2101-2105, October 1968.

[127] Shore, B., "Electro-Optic Crystals: A New Development in Information Storage," New Engineer, vol. 1, pp. 17-18, October 1971.

[128] Smith, A. W., "Injection Laser Writing on Chalcogenide Films," Appl. Optics, vol. 13, no. 4, pp. 795-798, April 1974.

[129] Smits, F. M. and Gallaher, L. E., "Design Consideration for a Semipermanent Optical Memory," Bell Sys. Tech. J., vol. 46, pp. 1267-1278, July-August 1967.

[130] Snaper, A. A., "The Ultimate Computer Memory," Optical Spectra, vol. 6, pp. 25-27, March 1972.

[131] Special Issue of Display Devices, IEEE Trans. on Electron Devices, vol. ED-20, no. 11, November 1973.

[132] Staebler, D. L. and Phillips, W., "Fe-Doped $LiNbO_3$ for Read-Write Applications," Appl. Optics, vol. 13, no. 4, pp. 788-794, April 1974.

[133] Stepke, E. T., "Optical Mass Memories: The Impossible Dream?" Electro-Optical Systems Design, vol. 4, pp. 12-20, October 1972.

[134] Stewart, W. C. and Cosentino, L. S., "Optics for a Read-Write Holographic Memory," Appl. Optics, vol. 9, no. 10, pp. 2271-2275, October 1970.

[135] Stewart, W. C., Mezrich, R. S., Cosentino, L. S., Nagle, E. M., Wendt, F. S., and Lohman, R. D., "An Experimental Read-Write Holographic Memory," RCA Review, vol. 34, pp. 3-44, March 1973.

[136] Strehlow, W. W., Dennison, R. L., and Packard, J. R., "Holographic Data Store," J. Opt. Soc. Am., vol. 64, p. 543, April 1974.

[137] Su, S. F. and Gaylord, T. K., "Calculation of Arbitrary-Order Diffraction Efficiencies of Thick Gratings with Arbitrary Grating Sahpe," J. Opt. Soc. Am., vol. 65, no. 1, pp. 59-64, January 1975.

[138] Sussman, A., "Electrooptic Liquid Crystals Devices: Principles and Applications," IEEE Trans. Parts. Hybrids, and Packaging, vol. PHP-8, no. 4, pp. 24-37, December 1972.

[139] Sutherlin, K. K., Lauer, J. P., and Olenick, R. W., "Holoscan: A Commercial Holographic ROM," Appl. Optics, vol. 13, no. 6, pp. 1345-1354, June 1974.

[140] Szentesi, O. I., "An Acoustooptic Page Composer Based on Bragg Imaging," Proc. IEEE, vol. 60, pp. 1461-1462, November 1972.

[141] Takeda, Y., Oshida, Y., and Miyamura, Y., "Random Phase Shifters for Fourier Transformed Holograms," Appl. Optics, vol. 11, no. 4, pp. 818-822, April 1972.

[142] Takeda, Y., "Digital Spatial Modulators," Appl. Optics, vol. 13, no. 4, pp. 825-831, April 1974.

[143] Tannas, Jr., L. E. and York, P. K., "Liquid Crystal/Ferroelectric Matrix Addressable Display," Ferroelectrics, vol. 10, pp. 19-22, 1976.

[144] Taylor, G. W., "A Method of Matrix Addressing Polarization Rotating or Retarding Light Valve Arrays," Proc. IEEE, vol. 58, no. 11, pp. 1812-1818, November 1970.

[145] Thaxter, J. B. and Kestigian, M., "Unique Properties of SBN and Their Use in a Layered Optical Memory," Appl. Optics, vol. 13, no. 4, pp. 913-924, April 1974.

[146] Tomlinson, W. J., "Phase Holograms in Photochromic Materials," Appl. Optics, vol. 11, no. 4, pp. 823-831, April 1972.

[147] Tsukamoto, K., Ishil, A., Ishida, A., Sumi, M., and Uchida, N., "Holographic Information Retrieval System," Appl. Optics, vol. 13, no. 4, pp. 869-874, April 1974.

[148] Tufte, O. N. and Chen, D., "Optical Techniques for Data Storage," IEEE Spectrum, vol. 10, pp. 26-32, February 1973.

[149] Tufte, O. N. and Chen, D., "Optical Memories: Controlling the Beam," IEEE Spectrum, vol. 10, pp. 48-53, March 1973.

[150] Vallese, L. M., "Laser Recorders Deliver Real-Time Readout," Microwaves, vol. 10, no. 11, pp. 10-12, November 1971.

[151] Vander Lugt, A., "A Review of Optical Data-Processing Techniques," Optica Acta, vol. 15, pp. 1-33, 1968.

[152] Vander Lugt, A., "Design Relationships for Holographic Memories," Appl. Optics, vol. 12, no. 7, pp. 1675-1685, July 1973.

[153] Vander Lugt, A., "Packing Density in Holographic Systems," Appl. Optics, vol. 14, no. 5, pp. 1081-1087, May 1975.

[154] Vander Lugt, A., "Holographic Memories," Optical Information Processing, Y. E. Nesterikhin, G. W. Stroke, and W. E. Kock, Eds. New York: Plenum Press, 1976.

[155] van Heerden, P. J., "Theory of Optical Information Storage in Solids," Appl. Optics, vol. 2, no. 4, pp. 393-400, April 1963.

[156] White, D. L. and Feldman, M., "Liquid Crystal Light Valves," Electronics Letters, vol. 6, no. 26, pp. 837-840, December 1970.

[157] Wieder, H., "Superresolution in Optical Data Storage," Appl. Phys. Letters, vol. 22, no. 10, pp. 487-489, May 15, 1973.

[158] Williams, J. G., "Asymmetric Memory Hierarchies," Commun. of the ACM, vol. 16, no. 4, pp. 213-222, April 1973.

[159] Zech, R. G., "Data Storage in Volume Holograms," Ph.D. Thesis, University of Michigan, 1974.

[160] Zech, R. G., "Incoherent Superposition in Volume Phase Holograms," J. Opt. Soc. Am., vol. 64, no. 10, pg. 1396, October 1974.

[161] Zook, J. D., "Light Beam Deflector Performance: A Comparative Analysis," Appl. Optics, vol. 13, no. 4, pp. 875-887, April 1974.

III. VOLUME HOLOGRAPHY AND THICK GRATINGS

[1] Alferness, R., "Analysis of Optical Propagation in Thick Holographic Gratings," Appl. Phys., vol. 7, pp. 29-33, May 1975.

[2] Alferness, R. and Case, S. K., "Coupling in Doubly Exposed, Thick Holographic Gratings," J. Opt. Soc. Am., vol. 65, no. 6, pp. 730-739, June 1975.

[3] Alferness, R., "Analysis of Propagation at the Second-order Bragg Angle of a Thick Holographic Grating," J. Opt. Soc. Am., vol. 66, no. 4, pp. 353-363, April 1976.

[4] Alferness, R. C., "Optical Propagation in Holographic Gratings," Ph.D. Thesis, University of Michigan, 1976.

[5] Aristov, V. V. and Shekhtman, V. Sh., "Properties of Three-Dimensional Holograms," Sov. Phys. Uspekhi, vol. 14, no. 3, pp. 263-277, Nov.-Dec. 1971.

[6] Ashby, N. and Miller, S. C., "Interference Theory of Reflection from Multilayered Media," J. Opt. Soc. Am., vol. 67, no. 4, pp. 448-453, April 1977.

[7] Bader, T. R., "Hologram Gratings: Amplitude and Phase Components," Applied Optics, vol. 14, no. 12, pp. 2818-2819, December 1975.

[8] Bartolini, R. A., Bloom, A., and Escher, J. S., "Multiple Storage of Holograms in an Organic Medium," Appl. Phys. Letters, vol. 28, no. 9, pp. 506-507, May 1976.

[9] Bartolini, R. A., Bloom, A., and Weakliem, H. A., "Volume Holographic Recording Characteristics of an Organic Medium," Appl. Optics, vol. 15, no. 5, pp. 1261-1265, May 1976.

[10] Batterman, B. W. and Cole, H., "Dynamical Diffraction of X-Rays by Perfect Crystals," Rev. Mod. Phys., vol. 36, no. 3, pp. 681-717, July 1964.

[11] Baugh, R. A., "High-efficiency Volume Holography," Ph.D. Thesis, Stanford University, 1969.

[12] Bergstein, L. and Kermisch, D., "Image Storage and Reconstruction in Volume Holography," Proc. Symp. on Modern Optics, MRI ser., vol. 17, Brooklyn, NY: Polytechnic Press, 1967, pp. 655-680.

[13] Berry, M. V., The Diffraction of Light by Ultrasound, Academic Press, New York, 1966.

[14] Biedermann, K., Ragnarsson, S., and Komlos, P., "Volume Holograms in Photographic Emulsions of Extended Thickness," Optics Comm., vol. 6, no. 2, pp. 205-209, October 1972.

[15] Bjorkholm, J. E. and Shank, C. V., "Higher-order Distributed Feedback Oscillators," Appl. Phys. Letters, vol. 20, pp. 306-308, April 15, 1972.

[16] Bosomworth, D. R. and Gerritsen, H. J., "Thick Holograms in Photochromic Materials," Appl. Optics, vol. 7, no. 1, pp. 95-98, January 1968.

[17] Brousseau, N. and Arsenault, H. H., "Emulsion Thickness and Space Variance: Combined Effects in Vander Lugt Optical Correlators," Appl. Optics, vol. 14, no. 7, pp. 1679-1682, July 1975.

[18] Burckhardt, C. B., "Diffraction of a Plane Wave at a Sinusoidally Stratified Dielectric Grating," J. Opt. Soc. Am., vol. 56, pp. 1502-1509, November 1966.

[19] Burckhardt, C. B., "Efficiency of a Dielectric Grating," J. Opt. Soc. Am., vol. 57, pp. 601-603, May 1967.

[20] Burke, W. J. and Sheng, P., "Crosstalk Noise From Multiple Thick-Phase Holograms," J. Appl. Phys., vol. 48, no. 2, pp. 681-685, February 1977.

[21] Case, S. K., "Coupled-wave Theory for Multiply Exposed Thick Holographic Gratings," J. Opt. Soc. Am., vol. 65, no. 6, pp. 724-729, June 1975.

[22] Case, S. K. and Alferness, R., "Index Modulation and Spatial Harmonic Generation in Dichromated Gelatin Films," Applied Physics, vol. 10, pp. 41-51, 1976.

[23] Case, S. K., "Multiple Exposure Holography in Volume Materials," Ph.D. Thesis, University of Michigan 1976.

[24] Case, S. K. and Russell, R. A., "Modular Optics Mode Converter," Appl. Optics, vol. 15, no. 10, pp. 2307-2308, October 1976.

[25] Chang, B. J. and Case, S. K., "Nonlinear Holographic Waveguide Coupler," Appl. Optics, vol. 15, pp. 1800-1802, July 1976.

[26] Cho, A. Y., Yariv, A., and Yeh, P., "Observation of Confined Propagation in Bragg Waveguides," Appl. Phys. Letters, vol. 30, no. 9, pp. 471-472, May 1977.

[27] Chu, R. S. and Tamir, T., "Guided-wave Theory of Light Diffraction by Acoustic Microwaves," IEEE Trans. Microwave Theo. and Tech., vol. MTT-18, pp. 486-504, August 1970.

[28] Chu, R. S., "The Diffraction of Bounded Electromagnetic Beams by Periodically-modulated Media," Ph.D. Thesis, Polytechnic Institute of Brooklyn, 1971.

[29] Chu, R. S. and Tamir, T., "Wave Propagation and Dispersion in Space-time Periodic Media," Proc. IEE, vol. 119, no. 7, pp. 797-806, July 1972.

[30] Chu, R. S. and Tamir, T., "Bragg Diffraction of Gaussian Beams by Periodically Modulated Media," J. Opt. Soc. Am., vol. 66, no. 3, pp. 220-226, March 1976.

[31] Chu, R. S. and Tamir, T., "Diffraction of Gaussian Beams by Periodically Modulated Media for Incidence Close to a Bragg Angle," J. Opt. Soc. Am., vol. 66, no. 12, pp. 1438-1440, December 1976.

[32] Chu, R. S. and Kong, J. A., "Modal Theory of Spatially Periodic Media," IEEE Trans. Microwave Theory and Tech., vol. MTT-25, pp. 18-24, January 1977.

[33] Close, D. H. and Moss, G. E., "Determination of Ray Directions in Ray Tracking Thick Holograms," J. Opt. Soc. of Am., vol. 63, pg. 1324, October 1973.

[34] Cohen, M. G. and Gordon, E. I., "Acoustic Scattering of Light in Fabry-Perot Resonator," Bell Sys. Tech. J., vol. 45, pp. 945-966, July-August 1966.

[35] Colburn, W. S. and Haines, K. A., "Volume Hologram Formation in Photopolymer Materials," Appl. Optics, vol. 10, pp. 1636-1641, July 1971.

[36] Collier, R. J., Burckhardt, C. B., and Lin, L. H., Optical Holography, Academic Press, New York, 1971, Chapter 9.

[37] Deen, L. M., Walkup, J. F., and Hagler, M. O., "Representations of Space-variant Optical Systems Using Volume Holograms," Appl. Optics, vol. 14, no. 10, pp. 2438-2446, October 1975.

[38] Elachi, C. and Yeh, C., "Periodic Structures in Integrated Optics," J. Appl. Phys., vol. 44, no. 7, pp. 3146-3152, July 1973.

[39] Elachi, C., "Waves in Active and Passive Periodic Structures: A Review," Proc. IEEE, vol. 64, no. 12, pp. 1666-1698, December 1976.

[40] Evans, G. and Wilcox, T., "Mode Coupling and Distributed Feedback Lasers in Periodic Fiber Waveguides," IEEE J. Quan. Elect., vol. QE-13, no. 4, pp. 145-152, April 1977.

[41] Forshaw, M. R. B., "The Imaging Properties and Aberrations of Thick Transmission Holograms," Optica Acta, vol. 20, no. 9, pp. 669-686, September 1973.

[42] Forshaw, M. R. B., "Thick Holograms: A Survey," Opt. and Laser Tech., vol. 6, pp. 28-35, February 1974.

[43] Forshaw, M. R. B., "Diffraction of a Narrow Laser Beam by a Thick Hologram: Experimental Results," Optics Communications, vol. 12, pp. 279-281, November 1974.

[44] Friesem, A. A., "Three-dimensional Recording Media in Holography, Ph.D. Thesis, The University of Michigan, 1968.

[45] Gaylord, T. K. and Tittel, F. K., "Angular Selectivity of Lithium Niobate Volume Holograms," J. Appl. Phys., vol. 44, pp. 4771-4773, October 1973.

[46] Ghizoni, C. C., Chen, B. U., and Tang, C. L., "Theory and Experiments on Grating Couplers for Thin-film Waveguides," IEEE J. Quantum Electronics, vol. QE-12, no. 2, pp. 69-73, February 1976.

[47] Guther, R. and Kusch, S., "Kinematic Theory of Gaussian Beams in Volume Holography," Sov. J. Quant. Electron., vol. 6, pp. 509-514, May 1976.

[48] Hsiao, S. S., "Resolution Distribution and Information Capacity of a Hologram," J. Opt. Soc. Am., vol. 63, no. 9, pp. 1108-1119, September 1973.

[49] Huignard, J. P., Herriau, J. P., and Micheron, F., "Coherent Selective Erasure of Superimposed Volume Holograms in $LiNbO_3$," Appl. Phys. Letters, vol. 26, no. 5, pp. 256-258, March 1975.

[50] Hutley, M. C. and Bird, V. M., "A Detailed Experimental Study of the Anomalies of a Sinusoidal Diffraction Grating," Optica Acta, vol. 20, no. 10, pp. 771-782, October 1973.

[51] Jaggard, D. L. and Elachi, C., "Floquet and Coupled-Waves Analysis of Higher-Order Bragg Coupling in a Periodic Medium," J. Opt. Soc. Am., vol. 66, no. 7, pp. 674-682, July 1976.

[52] Jaggard, D. L. and Elachi, C., "Higher-Order Bragg Coupling in Periodic Media with Gain or Loss," J. Appl. Phys., vol. 48, no. 4, pp. 1461-1466, April 1977.

[53] Johnson, R. V., "Temporal Responses of the Acoustooptic Modulator: Geometrical Optics Model in the Low Scattering Efficiency Limit," Applied Optics, vol. 16, pp. 507-514, February 1977.

[54] Jull, E. V., Heath, J. W., and Ebbeson, G. R., "Gratings that Diffract all Incident Energy," J. Opt. Soc. Am., vol. 67, no. 4, pp. 557-560, April 1977.

[55] Kalhor, H. A. and Moaveni, M. K., "Analysis of Diffraction Gratings by Finite-difference Coupling Techniques," J. Opt. Soc. Am., vol. 63, no. 12, pp. 1584-1588, December 1973.

[56] Kaspar, F. G., "Diffraction by Thick, Periodically Stratified Gratings with Complex Dielectric Constant," J. Opt. Soc. Am., vol. 63, no. 1, pp. 37-45, January 1973.

[57] Katzir, A., Livanos, A. C., and Yariv, A., "Chirped-grating Output Couplers in Dielectric Waveguides," Appl. Phys. Letters, vol. 30, no. 5, pp. 225-226, March 1, 1977.

[58] Katzir, A., Livanos, A. C., Shellan, J. B., and Yariv, A., "Chirped Gratings in Integrated Optics," IEEE J. Quant. Elect., vol. QE-13, no. 4, pp. 296-304, April 1977.

[59] Kawanishi, H., Suematsu, Y., and Kishino, K., "GaAs-Al_xGa_{1-x} As Integrated Twin-guide Lasers with Distributed Bragg Reflectors," IEEE J. Quantum Electron., vol. QE-13, pp. 64-65, February 1977.

[60] Kenan, R. P., "Theory of Diffraction of Guided Optical Waves by Thick Holograms," J. Appl. Phys., vol. 46, pp. 4545-4551, October 1975.

[61] Kermisch, D., "Image Storage and Reconstruction in Volume Holography," Ph.D. Thesis, Polytechnic Institute of Brooklyn, 1968.

[62] Kermisch, D., "Nonuniform Sinusoidally Modulated Dielectric Gratings," J. Opt. Soc. Am., vol. 59, no. 11, pp. 1409-1414, November 1969.

[63] Kermisch, D., "Efficiency of Photochromic Gratings," J. Opt. Soc. Am., vol. 61, no. 9, pp. 1202-1206, September 1971.

[64] Klein, W. R., Cook, B. D., and Mayer, W. G., "Light Diffraction by Ultrasonic Gratings," Acustica, vol. 15, no. 2, pp. 67-74, 1965.

[65] Klein, W. R. and Cook, B. D., "Unified Approach to Ultrasonic Light Diffraction," IEEE Trans. Sonics and Ultrasonics, vol. SU-14, no. 3, pp. 123-134, July 1967.

[66] Kogelnik, H., "Bragg Diffraction in Hologram Gratings with Multiple Internal Reflections," J. Opt. Soc. Am., vol. 57, pp. 431-433, March 1967.

[67] Kogelnik, H., "Coupled Wave Theory for Thick Hologram Gratings," Bell Sys. Tech. J., vol. 48, no. 4, pp. 2909-2947, November 1969.

[68] Kogelnik, H. and Sosnowski, T. P., "Holographic Thin Film Couplers," Bell Sys. Tech. J., vol. 49, pp. 1602-1608, September 1970.

[69] Kogelnik, H., "Filter Response of Nonuniform Almost-periodic Structures," Bell Syst. Tech. J., vol. 55, pp. 109-126, January 1976.

[70] Kowarschik, R., "Diffraction Efficiency of Attenuated Sinusoidally Modulated Gratings in Volume Holograms," Optica Acta, vol. 23, no. 12, pp. 1039-1051, 1976.

[71] Leith, E. G., Kozma, A., Upatnieks, J., Marks, J., and Massey, N., "Holographic Data Storage in Three-dimensional Media," Appl. Optics, vol. 5, no. 8, pp. 1303-1311, August 1966.

[72] Leith, E. N. and Kung, G. C., "Wavelength Dispersion in a Composite Volume Grating," Appl. Optics, vol. 15, no. 7, pp. 1679-1680, July 1976.

[73] Ludwig, U. W., "Generalized Grating Ray-tracing Equations," J. Opt. Soc. Am., vol. 63, no. 9, pp. 1105-1107, September 1973.

[74] Magnusson, R. and Gaylord, T. K., "Use of Dynamic Theory to Describe Experimental Results from Volume Holography," J. Appl. Phys., vol. 47, pp. 190-199, January 1976.

[75] MacQuigg, D. R., "Modulated-grating Hologram," Appl. Optics, vol. 16, pp. 1380-1389, May 1977.

[76] Marcuse, D., "Exact Theory of TE-wave Scattering from Blazed Dielectric Gratings," Bell Sys. Tech. J., vol. 55, no. 9, pp. 1295-1317, November 1976.

[77] Marcuse, D., "Thick Dielectric Grating on Asymmetric Slab Waveguide," Bell Sys. Tech. J., vol. 56, no. 3, pp. 329-353, March 1977.

[78] Matthijsse, P., "Sufficient Conditions for a Thin-filter Description of Thick Phase Filters," J. Opt. Soc. Am., vol. 65, pp. 1337-1341, November 1975.

[79] Moran, J. M. and Kaminow, I. P., "Properties of Holographic Gratings Photo-induced in Polymethyl Methacrylate," Appl. Optics, vol. 12, pp. 1964-1970, August 1973.

[80] Motoki, T., "Low Voltage Optical Modulator Using Electrooptically Induced Phase Gratings," Appl. Optics, vol. 12, no. 7, pp. 1472-1476, July 1973.

[81] Nguyen, L. T. and Tsai, C. S., "Efficient Wideband Guided-wave Acoustooptic Bragg Diffraction Using Phased Surface Acoustic Wave Array in $LiNbO_3$ Waveguides," Appl. Optics, vol. 16, pp. 1297-1304, May 1977.

[82] Ninomiya, Y., "Recording Characteristics of Volume Holograms," J. Opt. Soc. Am., vol. 63, no. 9, pp. 1124-1130, September 1973.

[83] Ohmachi, Y. and Noda, J., "$LiNbO_3$ TE-TM Mode Converter Using Collinear Acoustooptic Interaction," IEEE J. Quantum Electron., vol. QE-13, pp. 43-46, February 1977.

[84] Peng, S. T., Tamir, T., and Bertoni, H. L., "Theory of Periodic Dielectric Waveguides," IEEE Trans. Microwave Theo. and Tech., vol. MTT-23, pp. 123-133, January 1975.

[85] Phariseau, P., "On the Diffraction of Light by Progressive Supersonic Waves," Proc. Indian Acad. Sci., vol. 44A, pp. 165-170, 1956.

[86] Ragnarsson, S. I., "Holograms Recorded in Extremely Thick Photographic Emulsions," Optics Commun., vol. 14, no. 1, pp. 39-41, May 1975.

[87] Rigrod, W. W., "Diffraction Efficiency of Nonsinusoidal Bragg Reflection Gratings," J. Opt. Soc. Am., vol. 64, pp. 97-99, January 1974, vol. 64, pg. 895E, 1974.

[88] Rose, H. W., "Holographic Lens Systems," Ph.D. Thesis, Ohio State University, 1973.

[89] Roumiguieres, J. L., Maystre, D., and Petit, R., "On Efficiencies of Rectangular-groove Gratings," J. Opt. Soc. Am., vol. 66, no. 8, pp. 772-775, August 1976.

[90] Schmackpfeffer, A., Jarisch, W., and Kuicke, W. W., "High-efficiency Phase-hologram Gratings," IBM J. Res. Develop., vol. 14, pp. 533-538, September 1970.

[91] Schonnagel, H., "Recording and Reading of Volume Holograms in Diffraction-limited Systems," Sov. J. Quant. Electron., vol. 5, pp. 877-880, 1976.

[92] Shankoff, T. A., "Phase Holograms in Dichromated Gelatin," Appl. Optics, vol. 7, no. 10, pp. 2101-2105, October 1968.

[93] Shono, Y., "Reconstructed Images from Volume Holograms in the Fraunhofer Approximation: Analysis by a New Spherical-Wave Explosion," J. Opt. Soc. Am., vol. 66, pp. 564-574, June 1976.

[94] Siegman, A. E., "Bragg Diffraction of a Gaussian Beam by a Crossed-Gaussian Volume Grating," J. Opt. Soc. Am., vol. 67, no. 4, pp. 545-550, April 1977.

[95] Singh, K., Rattan, R., and Jain, N. K., "Diffraction Images of Truncated Sine and Square Wave Periodic Objects in the Presence of Linear Image Motion," Appl. Optics, vol. 12, no. 8, pp. 1864-1850, August 1973.

[96] Smith, H. M., "Effect of Emulsion Thickness on the Diffraction Efficiency of Amplitude Holograms," J. Opt. Soc. Am., vol. 62, no. 6, pp. 802-806, June 1972.

[97] Staebler, D. L. and Amodei, J. J., "Coupled-wave Analysis of Holographic Storage in $LiNbO_3$," J. Appl. Phys., vol. 43, pp. 1042-1049, March 1972.

[98] Staebler, D. L., Burke, W. J., Phillips, W., and Amodei, J. J., "Multiple Storage and Erasure of Fixed Holograms in Fe-doped $LiNbO_3$," Appl. Phys. Letters, vol. 26, no. 4, pp. 182-184, February 1975.

[99] Storck, E. and Wolff, U., "On the Theory of Diffraction by Holographic Gratings," J. Appl. Phys., vol. 46, pg. 3509, August 1975.

[100] Streifer, W., Scifres, D. R., and Burnham, R. D., "TM-Mode Coupling Coefficients in Guided-wave Distributed Feedback Lasers," IEEE J. Quantum Electron., vol. QE-12, no. 2, pp. 74-78, February 1976.

[101] Streifer, W., Scifres, D. R., and Burnham, R. D., "Analysis of Grating-Coupled Radiation in GaAs:GaAlAs Lasers and Waveguides," IEEE J. Quantum Electron., vol. QE-12, July 1976.

[102] Streifer, W., Scifres, D. R., and Burnham, R. D., "Perturbation Analysis of Nonuniform Almost-Periodic Bragg Reflectors," J. Opt. Soc. Am., vol. 66, no. 12, pp. 1359-1363, December 1976.

[103] Streifer, W., Scifres, D. R., Burnham, R. D., and MacDonald, R. I., "On Grating-coupled Radiation from Waveguides," IEEE J. Quantum Electron., vol. QE-13, pp. 67-68, February 1977.

[104] Streifer, W., Scifres, D. R., and Burnham, R. D., "Coupled Wave Analysis of DFB and DBR Lasers," IEEE J. Quantum Electron., vol. QE-13, no. 4, pp. 134-141, April 1977.

[105] Su, S. F. and Gaylord, T. K., "Calculation of Arbitrary-order Diffraction Efficiencies of Thick Gratings with Arbitrary Grating Shape," J. Opt. Soc. Am., vol. 65, no. 1, pp. 59-64, January 1975.

[106] Su, S. F. and Gaylord, T. K., "Refractive-index Profile and Physical Process Determination in Thick Gratings in Electrooptic Crystals," Appl. Optics, vol. 15, no. 9, pp. 1947-1952, August 1976.

[107] Tamir, T., Wang, H. C., and Oliner, A. A., "Wave Propagation in Sinusoidally Stratified Dielectric Media," IEEE Trans. Microwave Theo. and Tech., vol. MTT-12, pp. 323-335, May 1964.

[108] Tamir, T. and Wang, H. C., "Scattering of Electromagnetic Waves by a Sinusoidal Stratified Half-Space, I," Canadian J. Phys., vol. 44, pp. 2073-2093, September 1966.

[109] Tamir, T., "Scattering of Electromagnetic Waves by a Sinusoidal Stratified Half-Space, II," Canadian J. Phys., vol. 44, pp. 2461-2494, October 1966.

[110] Tomlinson, W. J. and Aumiller, G. D., "Technique for Measuring Refractive Index Changes in Photochromic Materials," Appl. Optics, vol. 14, no. 5, pp. 1100-1104, May 1975.

[111] Tomlinson, W. J., "Volume Holograms in Photochromic Materials," Appl. Optics, vol. 14, pp. 2456-2467, October 1975.

[112] Tomlinson, W. J., "Dynamics of Photochromic Conversion in Optically Thick Samples: Theory," Appl. Optics, vol. 15, no. 3, pp. 821-826, March 1976.

[113] Tomlinson, W. J., Chandross, E. A., Weber, H. P., and Aumiller, G. D., "Multicomponent Photopolymer Systems for Volume Phase Holograms and Grating Devices," Appl. Optics, vol. 15, no. 2, pp. 534-541, February 1976.

[114] Uchida, N., "Calculation of Diffraction Efficiency in Hologram Gratings Attenuated Along the Direction Perpendicular to the Grating Vector," J. Optical Soc. Am., vol. 63, no. 3, pp. 280-287, March 1973.

[115] Upatnieks, J. and Leonard, C., "Efficiency and Image Contrast of Dielectric Holograms," J. Opt. Soc. Am., vol. 60, pp. 297-305, March 1970.

[116] Upatnieks, J. and Leonard, C. D., "Characteristics of Dielectric Holograms," IBM J. Res. Develop., vol. 14,pp. 527-532, Sept. 1970.

[117] van Heerden, P. J., "Theory of Optical Information Storage in Solids," Appl. Optics, vol. 2, no. 4, pp. 393-400, April 1963.

[118] Vasilev, V. N., "Modulation Transfer Function of Phase Holograms," Sov. J. Quant. Electron., vol. 5, pp. 1276-1277, 1976.

[119] Waterman,P. C., "Scattering by Periodic Surfaces," J. Acoust. Soc. Am., vol. 57, no. 4, pp. 791-802, April 1975.

[120] Willard, G. W., "Criteria for Normal and Abnormal Ultrasonic Light Diffraction Effects," J. Acoust. Soc. Am., vol. 21, no. 2, pp. 101-108, March 1949.

[121] Yariv, A. and Armstrong, D. R., "Traveling Wave Oscillations in the Optical Region: A Theoretical Examination," J. Appl. Phys., vol. 44, no. 4, pp. 1664-1665, April 1973.

[122] Yariv, A. and Yen, H. W., "Bragg Amplification and Oscillation in Periodic Optical Media," Optics Comm., vol. 10, no. 2, pp. 120-122, February 1974.

[123] Yariv, A. and Gover, A., "Equivalence of the Coupled-Mode and Floquet-Bloch Formalisms in Periodic Optical Waveguides," Appl. Phys. Letters, vol. 26, no. 9, pp. 537-539, May 1, 1975.

[124] Yariv, A. and Yeh, P., "Electromagnetic Propagation in Periodic Stratified Media. II. Birefringence, Phase Matching, and X-Ray Lasers," J. Opt. Soc. Am., vol. 67, no. 4, pp. 438-448, April 1977.

[125] Yariv, A. and Nakamura, M., "Periodic Structures for Integrated Optics," IEEE J. Quantum Electron., vol. QE-13, no. 4, pp. 233-253, April 1977.

[126] Yeh, C., Casey, K. F., and Kapriellian, Z. A., "Transverse Magnetic Wave Propagation in Sinusoidally Stratified Dielectric Media," IEEE Trans. Microwave Theo. and Tech., vol. MTT-13, pp. 297-302, May 1965.

[127] Yeh, P., Yariv, A., and Hong, C. S., "Electromagnetic Propagation in Periodic Stratified Media. I. General Theory," J. Opt. Soc. Am., vol. 67, no. 4, pp. 423-438, April 1977.

[128] Young, L., Wong, W. K. Y., Thewalt, M. L. W., and Cornish, W. D., "Theory of Formation of Phase Holograms in Lithium Niobate," Appl. Phys. Letters, vol. 24, no. 6, pp. 264-265, March 15, 1974.

[129] Zech, R. G., "Data Storage in Volume Holograms," Ph.D. Thesis, University of Michigan, 1974.

[130] Zech, R. G., "Incoherent Superposition in Volume Phase Holograms," J. Opt. Soc. Am., vol. 64, no. 10, pg. 1396, October 1974.

IV. OPTICALLY-INDUCED REFRACTIVE INDEX CHANGES IN SOLIDS

[1] Alphonse, G. A., Alig, R. C., Staebler, D. L., and Phillips, W., "Time-dependent Characteristics of Photo-induced Space-charge Field and Phase Holograms in Lithium Niobate and Other Photorefractive Media," RCA Review, vol. 36, pp. 213-229, June 1975.

[2] Amodei, J. J. and Bosomworth, D. R., "Hologram Storage and Retrieval in Photochromic Strontium Titanate Crystals," Appl. Optics, vol. 8 no. 2, pp. 2473-2477, December 1969.

[3] Amodei, J. J., "Electron Diffusion Effects During Hologram Recording in Crystals," Appl. Phys. Letters, vol. 18, no. 1, pp. 22-24, January 1, 1971.

[4] Amodei, J. J., "Analysis of Transport Processes During Holographic Recording in Insulators," RCA Review, vol. 32, pp. 185-198, June 1971.

[5] Amodei, J. J. and Staebler, D. L., "Holographic Pattern Fixing in Electro-optic Crystals," Appl. Phys. Letters, vol. 18, pp. 540-542, June 15, 1971.

[6] Amodei, J. J., Phillips, W., and Staebler, D. L., "Improved Electro-optic Materials for Holographic Storage," IEEE J. Quantum Electronics, vol. QE-7, pg. 321, June 1971.

[7] Amodei, J. J., Staebler, D. L., and Stephens, A. W., "Holographic Storage in Doped Barium Sodium Niobate ($Ba_2NaNb_5O_{15}$)," Appl. Phys. Letters, vol. 18, pp. 507-509, June 1, 1971.

[8] Amodei, J. J., Phillips, W., and Staebler, D. L., "Holographic Storage Performance of Iron-Doped $LiNbO_3$," IEEE International Electron Device Meeting, pp. 112-114, October 1971.

[9] Amodei, J. J., Phillips, W., and Staebler, D. L., "Improved Electro-optic Materials and Fixing Techniques for Holographic Recording," Appl. Optics, vol. 11, no. 2, pp. 390-396, February 1972.

[10] Amodei, J. J. and Staebler, D. L., "Holographic Recording in Lithium Niobate," RCA Review, vol. 33, no. 1, pp. 71-93, March 1972.

[11] Amodei, J. J. and Staebler, D. L., "Holographic Storage in Electro-optic Crystals," IEEE J. of Quantum Electronics, vol. QE-9, no. 6, pp. 708-709, June 1973.

[12] Amodei, J. J. and Phillips, W., "Crystals for Recording Phase Holograms," U.S. Patent No. 3,915,549, assigned to RCA Corporation, October 28, 1975.

[13] Anderson, L. K., "Optical Applications of Ferroelectrics," Ferroelectrics, vol. 7, pp. 55-63, 1974.

[14] Ang, D., "The Role of Charge Transport in the Formation and Erasure of Volume Phase Holograms in Electrooptic Lithium Niobate," Ph.D. Thesis, Rice University, 1976.

[15] Ang, D. and Estle, T. L., "Phase Hologram Recording and Fatigue in $LiNbO_3$:Mn," Bull. Am. Phys. Soc., vol. 19, no. 3, pg. 259, March 1974.

[16] Apanasevich, P. A., Afanas'ev, A. A., and Urbanovich, A. I., "Mechanisms of Diffraction of Light by Optically Induced Gratings in Absorbing Media," Sov. J. Quant. Electron., vol. 5, no. 11, pp. 1320-1323, 1976.

[17] Ashkin, A., Boyd, G. D., Dziedzic, J. M., Smith, R. G., Ballman, A. A., Levinstein, J. J., and Nassau, K., "Optically-induced Refractive Index Inhomogeneities in $LiNbO_3$ and $LiTaO_3$," Appl. Phys. Letters, vol. 9, no. 1, pp. 72-74, July 1, 1966.

[18] Ashkin, A., Tell, B., and Dziedzic, M., "Laser Induced Refractive Index Inhomogeneities and Absorption Saturation Effects in CdS," IEEE J. Quantum Electron., vol. QE-3, no. 10, pp. 400-406, October 1967.

[19] Bass, M., "Nd:YAG Laser Irradiation-induced Damage to $LiNbO_3$ and KDP," IEEE J. Quantum Electron., vol. QE-7, pp. 350-359, July 1971.

[20] Biedermann, K., "Information Storage Materials for Holography and Optical Data Processing," Optica Acta, vol. 22, pp. 103-124, 1975.

[21] Burgess, J. W., Hurditch, R. J., Kirkby, C. J., and Scrivener, G. E., "Holographic Storage and Photoconductivity in PLZT Ceramic Materials," Appl. Optics, vol. 15, pp. 1550-1557, June 1976.

[22] Butusov, M. M., Gulyaev, S. N., and Sudarikov, V. V., "Holographic Efficiency and Mechanisms of Diffraction of Light in Holograms," Sov. J. Quant. Electron., vol. 5, no. 1, pp. 4-6, July 1975.

[23] Case, S. K. and Alferness, R., "Index Modulation and Spatial Harmonic Generation in Dichromated Gelatin Films," Appl. Phys., vol. 10, pp. 41-51, 1976.

[24] Chen, F. S., "A Laser Induced Inhomogeneity of Refractive Indices in KTN," J. Appl. Phys., vol. 38, pp. 3418-3420, July 1967.

[25] Chen, F. S., LaMacchia, J. T., and Fraser, D. B., "Holographic Storage in Lithium Niobate," Appl. Phys. Letters, vol. 13, pp. 223-225, October 1, 1968.

[26] Chen, F. S., "Optically Induced Change of Refractive Indices in $LiNbO_3$ and $LiTaO_3$," J. Appl. Phys., vol. 40, no. 8, pp. 3389-3396, July 1969.

[27] Cornish, W. D. and Young, L., "Influence of Multiple Internal Reflections and Thermal Expansion on the Effective Diffraction Efficiency of Holograms Stored in Lithium Niobate," J. Appl. Phys., vol. 46, no. 3, pp. 1252-1254, March 1975.

[28] Cornish, W. D., Moharam, M. G., and Young, L., "Effects of Applied Voltage on Hologram Writing in Lithium Niobate," J. Appl. Phys., vol. 47, no. 4, pp. 1479-1484, April 1976.

[29] Cornish, W. D., Young, L., and Thewalt, M. L. W., "Space Charge Fields: A Fringe Technique for Observing Such Fields During Hologram Writing in $LiNbO_3$," Appl. Optics, vol. 15, pp. 1258-1260, May 1976.

[30] Cornish, W. D., Moharam, M. G., and Young, L., "Ellipsometric Investigation of Optical Damage in Lithium Niobate," Ferroelectrics, vol. 10, pp. 153-157, 1976.

[31] Deigen, M. F., Odulov, S. G., Soskin, M. S., and Shanina, B. D., "Holographic Phase Gratings in Nonmetallic Crystals," Sov. Phys. Solid State, vol. 16, no. 7, pp. 1237-1241, January 1975.

[32] Fillmore, G. L. and Tynan, R. F., "Sensitometric Characteristics of Hardened Dichromated-Gelatin Films," J. Opt. Soc. Am., vol. 61, no. 3, pp. 199-203, February 1971.

[33] Fridkin, V. M., Guinzberg, A. V., Kochev, K. D., Verkhovskaya, K. A., and Volk, T. R., "To the Thermodynamics of the Effect of Optical Damage in Ferroelectric Crystals," Ferroelectrics, vol. 13, pp. 301-304, 1976.

[34] Friesem, A. A., Rav-Noy, Z., and Reich, S., "Photodielectric Polymer for Holographic Recording," Appl. Optics, vol. 16, no. 2, pp. 427-432, February 1977.

[35] Gaylord, T. K., Rabson, T. A., and Tittel, F. K., "Optically Erasable and Rewritable Solid-state Holograms," Appl. Phys. Letters, vol. 20, pp. 47-48, January 1, 1972.

[36] Gaylord, T. K., Rabson, T. A., Tittel, F. K., and Quick, C. R., "Pulsed Writing of Solid State Holograms," Appl. Optics, vol. 12, no. 2, pp. 414-415, February 1973.

[37] Gaylord, T. K., Rabson, T. A., Tittel, F. K., and Quick, C. R., "Self-enhancement of $LiNbO_3$ Holograms," J. Appl. Phys., vol. 44, no. 2, pp. 896-897, February 1973.

[38] Gaylord, T. K. and Tittel, F. K., "Angular Selectivity of Lithium Niobate Volume Holograms," J. Appl. Phys., vol. 44, no. 10, pp. 4771-4773, October 1973.

[39] Glass, A. M., von der Linde, D., and Negran, T. J., "High-voltage Bulk Photovoltaic Effect and the Photorefractive Process in $LiNbO_3$," Appl. Phys. Letters, vol. 25, no. 4, pp. 233-235, August 15, 1974.

[40] Glass, A. M. and von der Linde, D., "Photovoltaic, Photoconductive and Excited State Dipole Mechanisms for Optical Storage in Pyroelectrics," Ferroelectrics, vol. 10, pp. 163-166, 1976.

[41] Graube, A., "Holograms Recorded with Red Light in Dye Sensitized Dichromated Gelatin," Optics Comm., vol. 8, no. 3, pp. 251-253, July 1973.

[42] Gunter, P., Fluckiger, U., Huignard, J. P., and Micheron, F., "Optically Induced Refractive Index Changes in $KNbO_3$:Fe," Ferroelectrics, vol. 13, pp. 297-300, 1976.

[43] Huignard, J. P., Herriau, J. P., and Micheron, F., "Coherent Selective Erasure of Superimposed Volume Holograms in $LiNbO_3$," Appl. Phys. Letters, vol. 26, no. 5, pp. 256-258, March 1975.

[44] Huignard, J. P., Herriau, J. P., Micheron, F., and Rouchon, J. M., "Selective Erasure and Parallel Processing in Holograms Superimposed in $LiNbO_3$ Crystal," Conf. on Laser Engineering and Appl., pp. 8-9, May 28-30, 1975 and IEEE J. Quant. Electron., vol. QE-11, no. 9, pp. 8D-9D, September 1975.

[45] Huignard, J. P., Herriau, J. P., and Micheron, F., "Optical Storage in $LiNbO_3$:Fe with Selective Erasure Capability," Revue de Physique Appliquee, vol. 10, pp. 417-423, November 1975.

[46] Huignard, J. P. and Micheron, F., "Control of Sensitivity to Hologram Storage in $LiNbO_3$ using an Accessory Photovoltaic Crystal," Optics Comm., vol. 16, pp. 80-82, January 1976.

[47] Huignard, J. P. and Micheron, F., "High-sensitivity Read-Write Volume Holographic Storage in $Bi_{12}SiO_{20}$ and $Bi_{12}GeO_{20}$ Crystals," Appl. Phys. Letters, vol. 29, no. 9, pp. 591-593, November 1, 1976.

[48] Huignard, J. P., Herriau, J. P., and Micheron, F., "Selective Erasure and Processing in Volume Holograms Superimposed in Photosensitive Ferroelectrics," Ferroelectrics, vol. 10, pp. 393-396, 1976.

[49] Ishida, A., Mikami, O., Miyazawa, S., and Sumi, M., "Rh-Doped $LiNbO_3$ as an Improved New Material for Reversible Holographic Storage," Appl. Phys. Letters, vol. 21, no. 5, pp. 192-193, September 1972.

[50] Jarzebski, Z. M., "Review of Proposed Defect Structures in $LiNbO_3$," Mat. Res. Bull., vol. 9, pp. 233-240, March 1974.

[51] Johnston, Jr., W. D., "Optical Damage in $LiNbO_3$ and Other Pyroelectric Insulators," J. Appl. Phys., vol. 41, pp. 3279-3285, July 1970.

[52] Kenan, R. P., Vahey, D. W., Hartman, N. F., Wood, V. E., and Verber, C. M., "Integrated Optics Devices Utilizing Thick Phase Gratings," Optical Engineering, vol. 15, no. 1, pp. 12-16, Jan/Feb 1976.

[53] Keune, W., Date, S. K., Dezsi, I., and Gonser, U., "Mossbauer-effect Study of Co^{57} and Fe^{57} Impurities in Ferroelectric $LiNbO_3$," J. Appl. Phys., vol. 46, no. 9, pp. 3914-3924, September 1975.

[54] Kim, D. M., Shah, R. R., Rabson, T. A., and Tittel, F. K., "Nonlinear Dynamic Theory for Photorefractive Phase Hologram Formation," Appl. Phys. Letters, vol. 28, no. 6, pp. 338-340, March 15, 1976.

[55] Kim, D. M., Shah, R. R., Rabson, T. A., and Tittel, F. K., "Study of the Equivalent Electron Drift Field Characteristics in $LiNbO_3$ by Phase Holography," Appl. Phys. Letters, vol. 29, no. 2, pp. 84-86, July 15, 1976.

[56] King, S. R., Hartwick, T. S., and Chase, A. B., "Optical Damage in KTN," Appl. Phys. Letters, vol. 21, no. 7, pp. 312-314, October 1972.

[57] Koch, W. T. H., Munser, R., Ruppel, W., and Wurfel, P., "Anomalous Photovoltage in $BaTiO_3$," Ferroelectrics, vol. 13, pp. 305-308, 1976.

[58] Kogelnik, H., "Coupled Wave Theory for Thick Hologram Gratings," Bell Sys. Tech. J., vol. 48, no. 4, pp. 2909-2947, November 1969.

[59] Kovachev, M., Suinov, V., and Mateeva, T., "Diffraction Efficiency of Discrete-carrier Holograms," Sov. J. Quantum Electron., vol. 6, pp. 1307-1309, November 1976.

[60] Kratzig, E. and Kurz, H., "Photo-induced Currents and Voltages in $LiNbO_3$," Ferroelectrics, vol. 13, pp. 295-296, 1976.

[61] Kubota, T., Ose, T., Sasaki, M., and Honda, K., "Hologram Formation with Red Light in Methylene Blue Sensitized Dichromated Gelatin," Appl. Optics, vol. 15, no. 2, pp. 556-558, February 1976.

[62] Kurtz, S. K., Perry, T. T., and Bergman, J. G., "Alphaiodic Acid: A Solution-grown Crystal for Nonlinear Optical Studies and Applications," Appl. Phys. Letters, vol. 12, no. 5, pp. 186-188, March 1, 1968.

[63] Kurz, H., "Wavelength Dependence on the Photorefractive Process in Doped $LiNbO_3$," Ferroelectrics, vol. 8, pp. 437-439, 1974.

[64] Kurz, H. and Kratzig, E., "Spectroscopic Investigation of the Photorefractive Recording and Erasure Process in $LiNbO_3$:Fe," Appl. Phys. Letters, vol. 26, no. 11, pp. 635-637, June 1975.

[65] Kurz, H., "Photorefractive Recording of Volume Holograms in Doped $LiNbO_3$," Ferroelectrics, vol. 13, pp. 291-294, 1976.

[66] Levinstein, H. J., Ballmann, A. A., Denton, R. T., Ashkin, A., and Dziedzic, J. M., "Reduction of the Susceptibility of Optically Induced Index Inhomogeneities in $LiTaO_3$ and $LiNbO_3$," J. Appl. Phys., vol. 38, pp. 3101-3102, July 1967.

[67] Lin, L. H., "Holographic Measurements of Optically Induced Refractive Index Inhomogeneities in Bismuth Titanate," Proc. IEEE, vol. 57, pp. 252-253, February 1969.

[68] Lin, L. H., "Method of Characterizing Hologram-recording Materials," J. Opt. Soc. Am., vol. 61, no. 2, pp. 203-208, February 1971.

[69] Lovins, G. H., "High Precision Path Difference Measurement," Appl. Optics, vol. 9, no. 8, pg. 1935, August 1970.

[70] Magnusson, R. and Gaylord, T. K., "Laser Scattering Induced Holograms in Lithium Niobate," Appl. Optics, vol. 13, no. 7, pp. 1545-1548, July 1974.

[71] Magnusson, R. and Gaylord, T. K., "Use of Dynamic Theory to Describe Experimental Results from Volume Holography," J. Appl. Phys., vol. 47, pp. 190-199, January 1976.

[72] Magnusson, R. and Gaylord, T. K., "Dynamically Produced Refractive-index Variations with Thickness of Volume Holograms in Electrooptic Crystals," Appl. Optics, vol. 15, pp. 3021-3024, December 1976.

[73] Micheron, F. and Bismuth, G., "Variation de Birefringence Induite Dans un Cristal de $LiNbO_3$," Optics Comm., vol. 3, pp. 390-394, August 1971.

[74] Micheron, F. and Bismuth, G., "Electrical Control of Fixation and Erasure of Holographic Patterns in Ferroelectric Materials," Appl. Phys. Letters, vol. 20, pp. 79-81, January 15, 1972.

[75] Micheron, F. and Bismuth, G., "Holographic Optical Storage Using Electrical Control of Fixation and Erasure in Ferroelectrics," Digest of Technical Papers, 1972 IEEE International Solid-State Circuits Conference, pp. 104-105, February 27, 1972.

[76] Micheron, F. and Bismuth, G., "Real Time Measurement of Induced Variation of Birefringence in Transparent Media," Rev. Sci. Instru., vol. 43, no. 2, pp. 292-293, February 1972.

[77] Micheron, F. and Bismuth, G., "Electrical Control in Photo Ferroelectrics for Optical Storage," Digest of Technical Papers, Topical Meeting on Optical Storage of Digital Data, pp. MB3-1--MB3-4, March 19-21, 1973.

[78] Micheron, F. and Bismuth, G., "Field and Time Thresholds for the Electrical Fixation of Holograms Recorded in $(Sr_{0.75}Ba_{0.25})Nb_2O_6$ Crystals," Appl. Phys. Letters, vol. 23, no. 2, pp. 71-72, June 15, 1973.

[79] Micheron, F., Mayeux, C., and Trotier, J. C., "Electrical Control in Photoferroelectric Materials for Optical Storage," Appl. Optics, vol. 13, no. 4, pp. 784-787, April 1974.

[80] Mikami, O., "Cu-diffused Layers in $LiNbO_3$ for Reversible Holographic Storage," Optics Comm., vol. 11, no. 1, pp. 30-32, May 1974.

[81] Mikami, O., "Electro-Optic Light Modulation with Holographic Gratings Stored in a Cu-diffused $LiNbO_3$ Plate," Optics Comm., vol. 19, no. 1, pp. 42-44, October 1976.

[82] Miller, R. C. and Nordland, W. A., "Relative Signs of Nonlinear Optical Coefficients of Polar Crystals," Appl. Phys. Letters, vol. 16, no. 4, pp. 174-176, February 15, 1970.

[83] Moharam, M. G., Cornish, W. D., and Young, L., "Experimental Method of Determining the Intrinsic Diffraction Efficiency of Holograms Stored by the Photorefractive Effect," Appl. Phys. Letters, vol. 28, no. 6, pp. 324-326, March 15, 1976.

[84] Moharam, M. G. and Young, L., "Hologram Writing by the Photorefractive Effect with Gaussian Beams at Constant Applied Voltage," J. Appl. Phys., vol. 47, no. 9, pp. 4048-4051, September 1976.

[85] Mollenauer, L. F. and Tomlinson, W. J., "Piecewise Interferometric Generation of Precision Gratings," Appl. Optics, vol. 16, no. 3, pp. 555-557, March 1977.

[86] Nogami, G. and Imasaki, M., "Holographic Recording and Erasing Properties in $LiNbO_3$," Ferroelectrics, vol. 10, pp. 403-405, 1976.

[87] Okamoto, E., Ikeo, H., and Muto, K., "Holographic Storage in U-doped $LiNbO_3$," Appl. Optics, vol. 14, no. 10, pp. 2453-2455, October 1975.

[88] Norman, S. L., "Holography in Unconventional Materials," Optical Spectra, vol. 4, pp. 26-30, November 1970.

[89] Ohmori, Y., Yasojima, Y., and Inuishi, Y., "Control of Optical Damage in Reduced $LiNbO_3$ by External Applied Field," Appl. Phys. Letters, vol. 25, no. 12, pp. 716-717, December 15, 1974.

[90] Parsons, R., Cornish, W. D., and Young, L., "Luminescence Due to Iron Centers in Lithium Niobate," Appl. Phys. Letters, vol. 27, no. 12, pp. 654-656, December 15, 1975.

[91] Peterson, G. E., Glass, A. M., and Negran, T. J., "Control of the Susceptibility of Lithium Niobate to Laser-induced Refractive Index Changes," Appl. Phys. Letters, vol. 19, pp. 130-132, September 1, 1971.

[92] Phillips, W., Amodei, J. J., and Staebler, D. L., "Optical and Holographic Storage Properties of Transition Metal Doped Lithium Niobate," RCA Review, vol. 33, no. 1, pp. 94-109, March 1972.

[93] Phillips, W. and Staebler, D. L., "Control of the Fe^{2+} Concentration in Iron-Doped Lithium Niobate," J. Electron. Mat., vol. 3, no. 2, pp. 601-617, May 1974.

[94] Rouchon, J. M., Vergnolle, M., and Micheron, F., "Photoinduced Changes of Refractive Index in PLZT Ceramics," Ferroelectrics, vol. 10, pp. 389-392, 1976.

[95] Serreze, H. B. and Goldner, R. B., "Study of the Wavelength Dependence of Optically Induced Birefringence Change in Undoped $LiNbO_3$," Appl. Phys. Letters, vol. 22, pp. 626-627, June 1973.

[96] Shah, P., Rabson, T. A., Tittel, F. K., and Gaylord, T. K., "Volume Holographic Recording and Storage in Fe-Doped $LiNbO_3$ using Optical Pulses," Appl. Phys. Letters, vol. 24, no. 3, pp. 130-131, February 1974.

[97] Shah, R. R., Kim, D. M., Rabson, T. A., and Tittel, F. K., "Photorefractive Materials for Optical Storage and Display," Proc. SPIE, vol. 83, pp. 15-24, 1976.

[98] Shah, R. R., Kim, D. M., Rabson, T. A., and Tittel, F. K., "Characterization of Iron-doped Lithium Niobate for Holographic Storage Applications," J. Appl. Phys., vol. 47, pp. 5421-5431, December 1976.

[99] Shankoff, T. A., "Phase Holograms in Dichromated Gelatin," Appl. Optics, vol. 7, pp. 2101-2105, October 1968.

[100] Smakula, P. H. and Claspy, P. C., "The Electro-optic Effect in $LiNbO_3$ and KTN," Trans. of the Metallurgical Society of AIME, vol. 239, pp. 421-424, March 1967.

[101] Spencer, E. G., Lenzo, P. V., and Ballman, A. A., "Dielectric Materials for Electro-optic and Ultrasonic Device Applications," Proc. IEEE, vol. 55, no. 12, pp. 2074-2108, December 1967.

[102] Spinhirne, J. M. and Estle, T. L., "Laser Induced Refractive Index Changes in $LiTaO_3$," Bull. Am. Phys. Soc., vol. 19, no. 3, pg. 259, March 1974.

[103] Spinhirne, J. M. and Estle, T. L., "Sensitivity and Fatigue of $LiTaO_3$ for Holographic Recording," Appl. Phys. Letters, vol. 23, no. 1, pp. 38-39, July 1974.

[104] Spinhirne, J. M., Ang, D., Joiner, C. S. and Estle, T. L., "Simultaneous Holographic and Photocurrent Studies of the Photorefractive Effect in $LiTaO_3$ and $LiNbO_3$," Appl. Phys. Letters, vol. 30, no. 2, pp. 89-91, January 15, 1977.

[105] Smith, R. G., Fraser, D. B., Denton, R. T., and Rich, T. C., "Correlation of Reduction in Optically Induced Refractive-index Inhomogeneity with OH Content in $LiTaO_3$ and $LiNbO_3$," J. Appl. Phys., vol. 39, pp. 4600-4602, September 1968.

[106] Staebler, D. L. and Amodei, J. J., "Coupled-wave Analysis of Holographic Storage in $LiNbO_3$," J. Appl. Phys., vol. 43, pp. 1042-1049, March 1972.

[107] Staebler, D. L., Amodei, J. J., and Phillips, W., "Multiple Storage of Thick Phase Holograms in $LiNbO_3$," Digest of Technical Papers, 1972 International Quantum Electronics Conference, pg. 93, May 8-17, 1972, and IEEE J. Quantum Electron., vol. QE-8, no. 6, pg. 611, June 1972.

[108] Staebler, D. L. and Amodei, J. J., "Thermally Fixed Holograms in $LiNbO_3$," Ferroelectrics, vol. 3, pp. 107-113, April 1972 and IEEE Trans. Sonics & Ultrasonics, vol. SU-19, pp. 107-113, April 1972.

[109] Staebler, D. L. and Phillips, W., "Hologram Storage in Photochromic $LiNbO_3$," Appl. Phys. Letters, vol. 24, pp. 268-270, March 15, 1974.

[110] Staebler, D. L. and Phillips, W., "Fe-doped $LiNbO_3$ for Read-Write Applications," Appl. Optics, vol. 13, no. 4, pp. 788-794, April 1974.

[111] Staebler, D. L., Burke, W. J., Phillips, W., and Amodei, J. J., "Multiple Storage and Erasure of Fixed Holograms in Fe-doped $LiNbO_3$," Appl. Phys. Letters, vol. 26, no. 4, pp. 182-184, February 1975.

[112] Su, S. F. and Gaylord, T. K., "Unified Approach to the Formation of Phase Holograms in Ferroelectric Crystals," J. Appl. Phys., vol. 46, pp. 5208-5213, December 1975.

[113] Su, S. F. and Gaylord, T. K., "Determination of Physical Parameters and Processes in Hologram Formation in Ferroelectrics," J. Appl. Phys., vol. 47, no. 6, pp. 2757-2758, June 1976.

[114] Su, S. F. and Gaylord, T. K., "Refractive-index Profile and Physical Process Determination in Thick Gratings in Electrooptic Crystals," Appl. Optics, vol. 15, no. 9, pp. 1947-1952, August 1976.

[115] Su, S. F., "Determination of Grating Shape and Physical Mechanisms in Lithium Niobate Holographic Recording," Ph.D. Thesis, Georgia Institute of Technology, 1976.

[116] Sweeney, D. W. and Vest, C. M., "Reconstruction of Three-dimensional Refractive Index Fields from Multidirectional Interferometric Data," Appl. Optics, vol. 12, no. 11, pp. 2649-2664, November 1973.

[117] Thaxter, J. B., "Electrical Control of Holographic Storage in Strontium-Barium Niobate," Appl. Phys. Letters, vol. 15, no. 7, pp. 210-212, October 1, 1969.

[118] Tomlinson, W. J., Kaminow, I. P., Chandross, E. A., Fork, R. L., and Silfvast, W. T., "Photo Induced Refractive Index Increase in Poly(methylmethacrylate) and Its Applications," Appl. Phys. Letters, vol. 16, no. 12, pp. 486-489, June 15, 1970.

[119] Tomlinson, W. J. and Aumiller, G. D., "Technique for Measuring Refractive Index Changes in Photochromic Materials," Appl. Optics, vol. 14, no. 5, pp. 1100-1103, May 1975.

[120] Tomlinson, W. J., Chandross, E. A., Weber, H. P., and Aumiller, G. D., "Multicomponent Photopolymer Systems for Volume Phase Holograms and Grating Devices," Appl. Optics, vol. 15, pp. 534-541, February 1976.

[121] Townsend, R. L. and LaMacchia, J. T., "Optically Induced Refractive Index Changes in $BaTiO_3$," J. Appl. Phys., vol. 41, no. 13, pp. 5188-5192, December 1970.

[122] Urbach, J. C. and Meier, R. W., "Properties and Limitations of Hologram Recording Materials," Appl. Optics, vol. 8, pp. 2269-2281, November 1969.

[123] Vahey, D. W., "A Nonlinear Coupled-Wave Theory of Holographic Storage in Ferroelectric Materials," J. Appl. Phys., vol. 46, no. 8, pp. 3510-3515, August 1975.

[124] Vallese, L. M., "Laser Recorders Deliver Real-Time Readout," Microwaves, vol. 10, no. 11, pp. 10-12, November 1971.

[125] Verber, C. M., Wood, V. E., Kenan, R. P., and Hartman, N. F., "Large-angle Optical Switching in Waveguides in $LiNbO_3$," Ferroelectrics, vol. 10, pp. 253-256, 1976.

[126] Verber, C. M., Hartman, N. F., and Glass, A. M., "Formation of Integrated Optics Components by Multiphonon Photorefractive Processes," Appl. Phys. Letters, vol. 30, no. 6, pp. 272-273, March 15, 1977.

[127] von der Linde, D., Glass, A. M., and Rodgers, K. F., "Multiphoton Photorefractive Processes for Optical Storage in $LiNbO_3$," Appl. Phys. Letters, vol. 25, no. 3, pp. 155-157, August 1, 1974.

[128] von der Linde, D., Glass, A. M., and Rodgers, K. F., "High-sensitivity Optical Recording in KTN by Two-photon Absorption," Appl. Phys. Letters, vol. 26, no. 1, pp. 22-24, January 1975.

[129] von der Linde, D. and Glass, A. M., "Photorefractive Effects for Reversible Holographic Storage of Information," Applied Physics, vol. 8, pp. 85-100, 1975.

[130] von der Linde, D., Glass, A. M. and Rodger, K. M., "Optical Storage Using Refractive Index Changes Induced by Two-Step Excitation," J. Appl. Phys., vol. 47, pp. 217-220, January 1976.

[131] von der Linde, D. and Glass, A. M., "Multiphoton Processes for Optical Storage in Pyroelectrics," Ferroelectrics, vol. 10, pp. 5-7, 1976.

[132] Voronov, V. V., Kuz'minov, Y. S. and Osiko, V. V., "Optically Induced Changes in the Refractive Index of Ferroelectric Crystals and Their Use in Reuseable Holographic Memories (Review)," Sov. J. Quantum Electron., vol. 6, no. 10, pp. 1143-1157, October 1976.

[133] Wax, S. I., Chodorow, M. and Puthoff, H. E., "Optical Damage in KDP," Appl. Phys. Letters, vol. 16, no. 4, pp. 157-159, February 15, 1970.

[134] Williams, B. F., Burke, W. J., and Staebler, D. L., "Mobile Si Ions in Fe-doped $LiNbO_3$ Crystals," Appl. Phys. Lett., vol. 28, no. 4, pp. 224-226, February 1976.

[135] Wood, V. E., "Optical Damage and Internal Fields in Pyroelectrics," J. Appl. Phys., vol. 44, pp. 1391-1392, March 1973.

[136] Wood, V. E., Hartman, N. F., Verber, C. M., and Kenan, R. P., "Holographic Formation of Gratings in Optical Waveguiding Layers," J. Appl. Phys., vol. 46, pp. 1214-1215, March 1975.

[137] Young, L., Wong, W. K. Y., Thewalt, M. L. W. and Cornish, W. D., "Theory of Formation of Phase Holograms in Lithium Niobate," Appl. Phys. Letters, vol. 24, no. 6, pp. 264-265, March 15, 1974.

V. OPTICAL PROPERTIES OF MATERIALS RELATED TO OPTICAL STORAGE

[1] Abrahams, S. C., Reddy, J. M., and Bernstein, J. L., "Ferroelectric Lithium Niobate. No. 3. Single Crystal X-Ray Diffraction Study at 24°C," J. Phys. Chem. Solids, vol. 27, pp. 997-1012, June/July 1966.

[2] Abrahams, S. C., Hamilton, W. C., and Reddy, J. M., "Ferroelectric Lithium Niobate. No. 4. Single Crystal Neutron Diffraction Study at 24°C," J. Phys. Chem. Solids, vol. 27, pp. 1013-1018, June/July

[3] Abrahams, S. C., Levinstein, H. J., and Reddy, J. M., "Ferroelectric Lithium Niobate. No. 5. Polycrystal X-Ray Diffraction Study Between 24°C and 200°C," J. Phys. Chem. Solids, vol. 27, pp. 1019-1026, June/July 1966.

[4] Aldrich, R. E., Hou, S. L., and Harvill, M. L., "Electrical and Optical Properties of $Bi_{12}SiO_{20}$," J. Appl. Phys., vol. 42, no. 1, pp. 493-494, January 1971.

[5] Alig, R. C., "Acoustic Diffraction and the Electrostrictive Transducer," J. Appl. Phys., vol. 46, no. 9, pp. 3731-3737, September 1975.

[6] Biedermann, K., "Information Storage Materials for Holography and Optical Data Processing," Optica Acta, vol. 22, no. 2, pp. 103-124, 1975.

[7] Boyd, G. D., Miller, R. C., Nassau, K., Bond, W. L., and Savage, A., "$LiNbO_3$: An Efficient Phase Matchable Nonlinear Optical Material," Appl. Phys. Letters, vol. 5, no. 11, pp. 234-236, December 1, 1964.

[8] Bridenbaugh, P. M., Carruthers, J. R., Dziedzic, J. M., and Nash, F. R., "Spatially Uniform and Alternate SHG Phase-matching Temperatures in Lithium Niobate," Appl. Phys. Letters, vol. 17, no. 3, pp. 104-106, August 1, 1970.

[9] Campillo, A. J. and Tang, C. L., "Spontaneous Parametric Scattering of Light in $LiIO_3$," Appl. Phys. Letters, vol. 16, no. 6, pp. 242-244, March 15, 1970.

[10] Chen, D., Otto, G. N., and Schmit, F. M., "MnBi Films for Magneto-optic Recording," IEEE Trans. Mag., vol. MAG-9, no. 2, pp. 66-83, June 1973.

[11] Chen, F. S., Geusic, J. E., Kurtz, S. K., Skinner, J. G., and Wemple, S. H., "Light Modulation and Beam Deflection with Potassium Tantalate-Niobate Crystals," J. Appl. Phys., vol. 37, no. 1, pp. 388-398, January 1966.

[12] Chin, G. Y., Ballman, A. A., Tien, P. K., and Riva-Sanseverino, S., "Diffusion Kinetics and Optical Quality in $LiNbO_3$-$LiTaO_3$ Optical Waveguides," Appl. Phys. Letters, vol. 26, no. 11, pp. 637-639, June 1975.

[13] Cummins, S. E., "A New Bistable Ferroelectric Light Gate or Display Element," Proc. IEEE, vol. 55, no. 8, pp. 1537-1538, August 1967.

[14] Cummins, S. E., "A New Optically Read Ferroelectric Memory," Proc. IEEE, vol. 55, no. 8, pp. 1536-1537, August 1967.

[15] Damon, R. W., McMahon, D. H., and Thaxter, J. B., "Materials for Optical Memories," Electro-Optical Systems Design, vol. 2, no. 8, pp. 68-77, August 1970.

[16] Daniel, M. R., "Acoustic Radiation from a High Coupling Cut of Lithium Niobate," J. Appl. Physics, vol. 44, no. 7, pp. 2942-2945, July 1973.

[17] Faughnan, B. W. and Kiss, Z. J., "Photoinduced Reversible Charge-Transfer Processes in Transition Metal-Doped Single-Crystal $SrTiO_3$ and TiO_2," Phys. Rev. Letters, vol. 21, no. 18, pp. 1331-1334, October 28, 1968.

[18] Glass, A. M., "Comment on 'Luminescence from $LiNbO_3$'," J. Appl. Phys., vol. 44, no. 1, pg. 508, January 1973.

[19] Glass, A. M. and Auston, D. H., "Excited State Dipole Moments of Impurities in Pyroelectric Crystals and Their Applications," Ferroelectrics, vol. 7, pp. 187-189, 1974.

[20] Hadni, A. and Thomas, R., "Localized Irreversible Thermal Switching of Spontaneous Polarization in Ferroelectrics by Laser," Ferroelectrics, vol. 7, pp. 177- , 1974.

[21] Hordvik, A. and Schlossberg, H., "Luminescence from $LiNbO_3$," Appl. Phys. Letters, vol. 20, no. 5, pp. 197-199, March 1972.

[22] Hordvik, A. and Schlossberg, H., "Luminescence from $LiNbO_3$," International Quantum Electronics Conference, May 8-17, Digest of Technical Papers, pp. 75-77 , 1972.

[23] Hordvik, A. and Schlossberg, H., "Reply to "Comment on 'Luminescence from $LiNbO_3$'"," J. Appl. Phys., vol. 44, no. 1, pg. 509, January 1973.

[24] Hou, S. L. and Oliver, D. S., "Pockels Readout Optical Memory Using $Bi_{12}SiO_{20}$," Appl. Physics Letters, vol. 18, no. 8, pp. 325-328, April 15, 1971.

[25] Jarzebski, Z. M., "Review of Proposed Defect Structures in $LiNbO_3$," Mat. Res. Bull, vol. 9, pp. 233-240, March 1974.

[26] Jerphagnon, J., "Invariants of the Third-Rank Cartesian Tensor: Optical Nonlinear Susceptibilities," Phys. Rev., vol. 2B, no. 4, pp. 1091-1098, August 15, 1970.

[27] Jerphagnon, J., "Optical Nonlinear Susceptibilities of Lithium Iodate," Appl. Phys. Letters, vol. 16, no. 8, pp. 298-299, April 15, 1970.

[28] Kaminow, I. P. and Stulz, L. W., "Nd:$LiNbO_3$ Laser," IEEE J. Quantum Electron., vol. QE-11, no. 6, pp. 306-308, June 1975.

[29] Kaspar, F. G. and Lamberts, R. L., "A Study of Photographic Characteristics Affecting the Relative Luminance of the Reconstructed Image of a Hologram," J. Opt. Soc. Am., vol. 56, pg. 1414, Oct. 1966.

[30] Kratzig, E. and Kurz, H., "Spectral Dependence of the Photorefractive Recording and Erasure Process in Doped $LiNbO_3$," Ferroelectrics, vol. 10, pp. 159-162, 1976.

[31] Kratzig, E. and Kurz, H., "Spectroscopic Investigation of Photovoltaic Effects in Doped $LiNbO_3$," J. Electrochem. Soc., vol. 123, pp. , 1976.

[32] Kurtz, S. K., Perry, T. T., and Bergman, J. G., "Alpha-iodic Acid: A Solution-grown Crystal for Nonlinear Optical Studies and Applications," Appl. Phys. Letters, vol. 12, no. 5, pp. 186-188, March 1, 1968.

[33] Lauer, R. B., "Electron Effective Mass and Conduction-band Effective Density of States in $Bi_{12}SiO_{20}$," J. Appl. Phys., vol. 45, no. 4, pp. 1794-1797, April 1974.

[34] Lenzo, P. V., Spencer, E. G., and Nassau, K., "Electro-Optic Coefficients in Single-Domain Ferroelectric Lithium Niobate," J. Opt. Soc. Am., vol. 56, no. 5, pp. 633-635, May 1966.

[35] Lenzo, P. V., Turner, E. H., Spencer, E. G., and Ballman, A. A., "Electro-Optic Coefficients and Elastic Wave Propagation in Single-Domain Ferroelectric Lithium Tantalate," Appl. Phys. Letters, vol. 8, no. 4, pp. 81-82, February 15, 1966.

[36] Lenzo, P. V., Spencer, E. G., and Ballman, A. A., "Photoactivity in Bismuth Germanium Oxide," Phys. Rev. Letters, vol. 19, no. 11, pp. 641-644, September 11, 1967.

[37] Miller, A. and Duffy, M. T., "Orientation of Crystals by Extinction Between Crossed Linear Polarizers," Appl. Optics, vol. 14, no. 4, pg. 809, April 1975.

[38] Miller, R. C. and Savage, A., "Temperature Dependence of the Optical Properties of Ferroelectric $LiNbO_3$ and $LiTaO_3$," Appl. Phys. Letters, vol. 9, no. 4, pp. 169-171, August 15, 1966.

[39] Miller, R. C. and Nordland, W. A., "Relative Signs of Nonlinear Optical Coefficients of Polar Crystals," Appl. Phys. Letters, vol. 16, no. 4, pp. 174-176, February 15, 1970.

[40] Nassau, K. and Levinstein, H. J., "Ferroelectric Behavior of Lithium Niobate," Appl. Phys. Letters, vol. 7, no. 3, pp. 69-70, August 1, 1965.

[41] Nassau, K., Levinstein, J. J., and Loiacono, G. M., "Ferroelectric Lithium Niobate No. 1. Growth, Domain Structure, Dislocations and Etching," J. Phys. Chem. Solids, vol. 27, pp. 983-988, June/July 1966.

[42] Nassau, K., Levinstein, J. J., and Loiacono, G. M., "Ferroelectric Lithium Niobate. No. 2. Preparation of Single Domain Crystals," J. Phys. Chem. Solids, vol. 27, pp. 989-996, June/July 1966.

[43] Nath, G. and Haussuhl, S., "Large Nonlinear Optical Coefficient and Phase Matched Second Harmonic Generation in $LiIO_3$," Appl. Phys. Letters, vol. 14, no. 5, pp. 154-156, March 1, 1969.

[44] Ng, W. K. and Woodbury, E. J., "Observation of the Simultaneous Generation of the Second, Third, and Fourth Harmonics of 1.06-μ Radiation in $Ba_2NaNb_5O_{15}$, $LiNbO_3$ and $LiIO_3$ Crystals," Appl. Phys. Letters, vol. 18, no. 12, pp. 550-552, June 15, 1971.

[45] Ninomiya, Y. and Motoki, T., "$LiNbO_3$ Light Modulator," Rev. Sci. Instr., vol. 43, no. 3, pp. 519-524, March 1972.

[46] Otaguro, W. S., Wiener-Avnear, W., and Porto, S. P. S., "Determination of the Second-Harmonic-Generation Coefficient and the Linear Electro-Optic Coefficient in $LiIO_3$ through Oblique Raman Phonon Measurements," Appl. Phys. Letters, vol. 18, no. 11, pp. 499-501, June 1, 1971.

[47] Phillips, W. and Staebler, D. L., "Control of the Fe^{2+} Concentration in Iron-Doped Lithium Niobate," J. Electron. Mat., vol. 3, no. 2, pp. 601-617, May 1974.

[48] Plourde, J. K., "Temperature Stable Microwave Dielectric Resonators Utilizing Ferroelectrics," Digest of Technical Papers, 1973 IEEE G-MTT International Microwave Symposium, pp. 202-204, June 1973.

[49] Rez, I. S., "Crystals with Non-Linear Polarizability," Sov. Phys. Uspekhi, vol. 10, no. 6, pp. 759-782, May/June 1968.

[50] Schneider, I., Collins, W. C., Marrone, M. J., and Gingerich, M. E., "Holographic Subtraction Using Anisotropic Centers in Alkali Halide Crystals," Appl. Phys. Letters, vol. 27, no. 6, pp. 348-350, September 15, 1975.

[51] Schneider, I. and Gingerich, M. E., "Diffraction by M Centers in KCL," Appl. Optics, vol. 15, no. 10, pp. 2428-2431, October 1976.

[52] Shah, M. L., "Optical Waveguides in $LiNbO_3$ by Ion Exchange Technique," Appl. Phys. Letters, vol. 26, no. 11, pp. 652-653, June 1975.

[53] Singh, S., Draegert, D. A., and Geusic, J. E., "Optical and Ferroelectric Properties of Barium Sodium Niobate," Phys. Rev., vol. 2B, October 1, 1970.

[54] Spencer, E. G., Lenzo, P. V., and Nassau, K., "Elastic Wave Propagation in Lithium Niobate," Appl. Phys. Letters, vol. 7, no. 3, pp. 67-69, August 1, 1965.

[55] Spencer, E. G., Lenzo, P. V., and Ballman, A. A., "Dielectric Materials for Electro-Optic and Ultrasonic Device Applications," Proc. IEEE, vol. 55, no. 12, pp. 2074-2108, December 1967.

[56] Sprague, R. A., "Effect of Bulk Carriers on PROM Sensitivity," J. Appl. Phys., vol. 46, no. 4, pp. 1673-1678, April 1975.

[57] Swindell, W., "Extraordinary-ray and -wave Tracing in Uniaxial Crystals," Appl. Optics, vol. 14, no. 9, pp. 2298-2301, September 1975.

[58] Toyoda, K., "Bibliography of Ferroelectrics," Ferroelectrics, vol. 3, pp. 59-66, 1971.

[59] Tsuya, H., Fujino, Y., and Sugibuchi, K., "Dependence of Second Harmonic Generation on Crystal Inhomogeneity," J. Appl. Phys., vol. 41, no. 6, pp. 2557-2563, May 1970.

[60] Turner, E. H., "High Frequency Electro-Optic Coefficients of Lithium Niobate," Appl. Phys. Letters, vol. 8, pp. 303-304, June 1, 1966.

[61] Van Uitert, L. G., Singh, S., Levinstein, H. J., Geusic, J. E., and Bonner, W. A., "A New and Stable Nonlinear Optical Material," Appl. Phys. Letters, vol. 11, no. 5, pp. 161-163, September 1, 1967.

[62] Vedam, K. and Davis, T. A., "Piezo- and Thermo-Optic Behavior of $LiNbO_3$," Appl. Phys. Letters, vol. 12, no. 4, pp. 138-140, February 15, 1968.

[63] Venables, J. D., "Damage-Induced Microdomains in $LiTaO_3$," Appl. Phys. Letters, vol. 25, pp. 254-256, September 1974.

[64] Venturini, E. L., Spencer, E. G., Lenzo, P. V., and Ballman, A. A., "Refractive Indices of Strontium Barium Niobate," J. Appl. Phys., vol. 39, pp. 343-344, January 1968.

[65] Venturini, E. L., Spencer, E. G., and Ballman, A. A., "Elasto-Optic Properties of $Bi_{12}GeO_{20}$, $Bi_{12}SiO_{20}$, and $Sr_xBa_{1-x}Nb_2O_6$," J. Appl. Phys., vol. 40, no. 4, pp. 1622-1624, March 1969.

[66] Voorhoeve, R. J. H., Johnson, D. W., Jr., Remeika, J. P., and Gallagher, P. K., "Perovskite Oxides: Materials Science in Catalysis," Science, vol. 195, no. 4281, pp. 827-833, March 1977.

[67] Warner, A. W., Onoe, M., and Coquin, G. A., "Determination of Elastic and Piezoelectric Constants for Crystals in Class (3m)," J. Acoust. Soc. of Am., vol. 42, pp. 1223-1231, June 1967.

[68] Wemple, S. H., DiDomencio, Jr., M., and Camlibel, I., "Relationship Between Linear and Quadratic Electro-Optic Coefficients in $LiNbO_3$ $LiTaO_3$, and Other Oxygen-Octahedra Ferroelectrics Based on Direct Measurement of Spontaneous Polarization," Appl. Phys. Letters, vol. 12, no. 6, pp. 209-211, March 15, 1968.

[69] Wemple, S. H., "Polarization Fluctuations and the Optical Absorption Edge in $BaTiO_3$," Phys. Rev., vol. 2B, pp. 2679-2689, October 1970.

[70] Wiesendanger, E., "Optical Properties of $KNbO_3$," Ferroelectrics, vol. 1, pp. 141-148, July 1970.

[71] Yasuhira, T., Morikawa, T., Shimada, J., and Sakurai, K., "Thermally Induced Bubblelike Patterns in Fe-doped $LiNbO_3$ Single Crystals," J. Appl. Phys., vol. 47, no. 4, pp. 1229-1231, April 1976.

[72] Zook, J. D., Chen, D., and Otto, G. N., "Temperature Dependence and Model of the Electro-Optic Effect in $LiNbO_3$," Appl. Phys. Letters, vol. 11, no. 5, pp. 159-161, September 1, 1967.

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REFERENCES TO BE ADDED

(a) Amodei, J. J., "Direct Optical Storage Media" in Handbook of Lasers with Selected Data on Optical Technology, (R. J. Pressley, ed.). Cleveland: Chemical Rubber Co., 1971, pp. 533-548.

(b) Feng, S. Y., Lai, H. M., and Su, L. K., "Phase Holograms and the Action of Bleaching," Appl. Optics, vol. 16, pp. 1800-1801, July 1977.

(c) Gibin, I. S. and Tverdokhleb, P. E., "Information Processing in Optical Systems of Holographic Memory Devices" in Optical Information Processing (Y. E. Nesterikhin, G. W. Stroke, and W. E. Kock, eds.). New York: Plenum Press, 1975, pp. 47-74.

(d) Haskal, H. and Chen, D., "Optical Storage of Data" in Laser Applications (M. Ross, ed.). New York: Academic Press, 1977, pp. 135-230.

(e) Kong, J. A., "Second-Order Coupled-Mode Equations for Spatially Periodic Media," J. Optical Soc. Am., vol. 67, pp. 825-829, June 1977.

(f) Landauer, R., "Optical Logic and Optically Accessed Digital Storage" in Optical Information Processing (Y. E. Nesterikhin, G. W. Stroke, and W. E. Kock, eds.). New York: Plenum Press, 1975, pp. 219-253.

(g) Magnusson, R., "Dynamic Theory of Volume Holographic Recording and Readout in Electro-Optic Crystals," Ph.D. Thesis, Georgia Institute of Technology, 1976.

(h) Magnusson, R. and Gaylord, T. K., "Analysis of Multi-Wave Diffraction of Thick Gratings," J. Optical Soc. Am., vol. 67, pp. - , September 1977.

(i) Pennington, K. S., "Holographic Parameters and Recording Materials" in Handbook of Lasers with Selected Data on Optical Technology (R. J. Pressley, ed.). Cleveland: Chemical Rubber Co., 1971, pp. 549-591.

(j) Schmahl, G. and Rudolph, D., "Holographic Diffraction Gratings" in Progress in Optics, vol. 14 (E. Wolf, ed.). Amsterdam: North-Holland Publishing Co., 1976, pp. 197-244.

(k) Vander Lugt, A., "Holographic Memories" in Optical Information Processing (Y. E. Nesterikhin, G. W. Stroke, and W. E. Kock, eds.). New York: Plenum Press, 1975, pp. 347-380.

(l) Yu, F. T. S., "A Note on Phase Holograms," Appl. Optics, vol. 8, pp. 2350-2351, November 1969.

(m) Yu, F. T. S., "Phase Holograms and the Action of Bleaching: Comments," Appl. Optics, vol. 16, pg. 1802, July 1977.

(n) Kratzig, E. and Kurz, H., "Photorefractive and Photovoltaic Effects in Doped $LiNbO_3$," Optica Acta, vol. 24, no. 4, pp. 475-482, 1977.

(o) Kurz, H., "Photorefractive recording dynamics and multiple storage of volume holograms in photorefractive $LiNbO_3$," Optica Acta, vol. 24, no. 4, pp. 463-473, 1977.

(p) Orlowski, R., Kratzig, and Kurz, H., "Photorefractive Effects in $LiNbO_3$:Fe Under External Electric Fields," Optics Communications, vol. 20, pp. 171-174, January 1977.